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The Teeth of Spur Wheels—Their Correct Formation in Theory and in Practice.

By Prof. C. W. MacCord.

No. III.

ARBITRARY PROPORTIONS.

It is not necessary in all cases, indeed probably not in the majority of cases, to pay particular attention to the relative amounts of the approaching and receding action. And it is a very common practice to make the whole height of the tooth a certain fraction of the pitch; the part which projects outside the pitch circle being made a little less than that within, by which the clearance is provided for. Thus, in Fig. 0, the whole height l, is $\frac{4}{5}$ of the pitch; and the part h is to d as 11 :13. Two other proportions which have been extensively used are as follows:

$l = \frac{2}{3}$ pitch; $h : d :: 4 : 5$.

$l = \frac{7}{10}$ " $h : d :: 3 : 4$.

Teeth proportioned according to either of these rules will work satisfactorily for most purposes, if there be at least 12 teeth upon the smallest wheel. But if occasion arises, as it may, for the use of a pinion with only six or eight "leaves" (as the teeth of very small wheels are sometimes called), it will be found advantageous, if not absolutely necessary, to make the faces of those leaves longer. As for the angle of action, and the proportion of the angle of approach to that of recess, both these things will, of course, vary according to the numbers of teeth, whichever of these systems be adopted. It may be added, that in connection with these rules, instructions are frequently given as to the amount of *back-lash*, which is also, according to them, a definite fraction of the pitch. This is, no doubt, very proper in reference to wheels cast from patterns; but there certainly does not seem to be any reason for it if the teeth are to be cut; whatever the pitch, it is practically sufficient that the backs of the teeth should barely clear each other when the fronts are in driving contact.

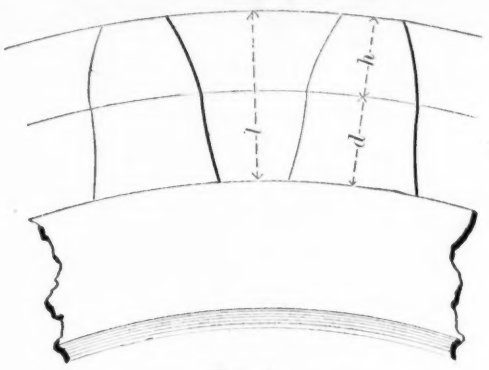
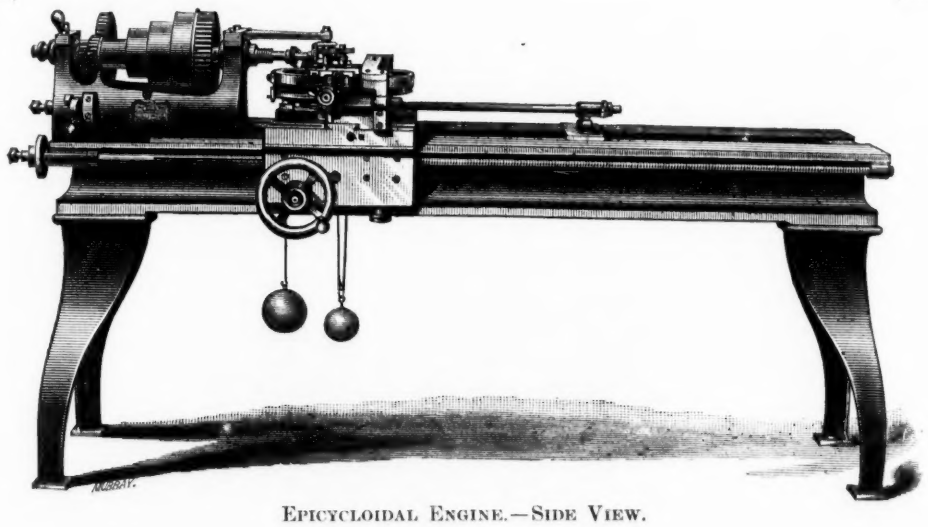
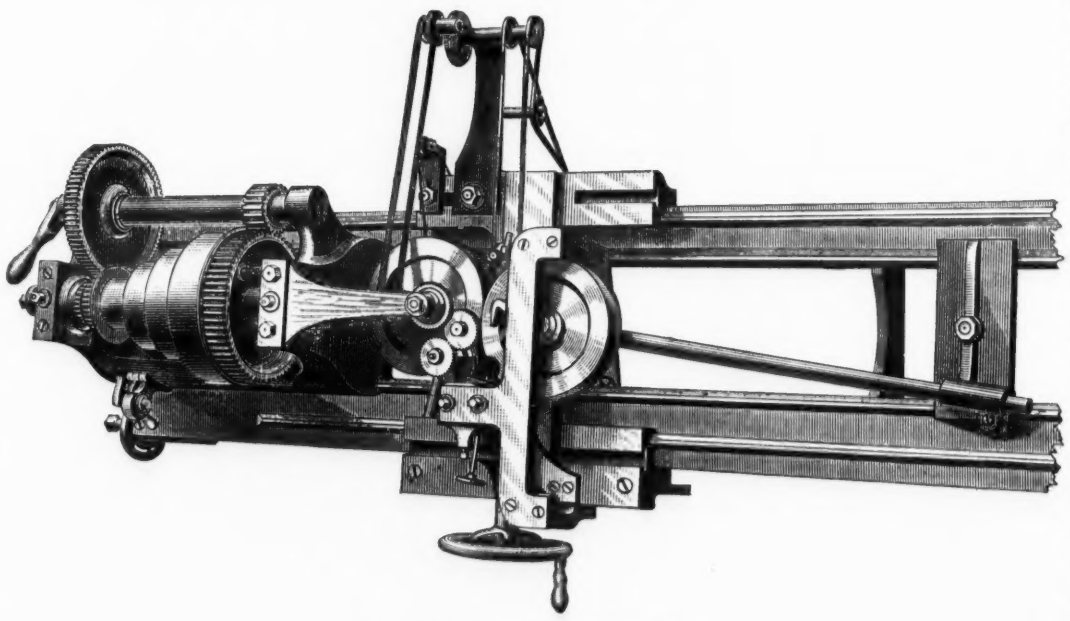


Fig. 0.



Epicycloidal Engine.—Side View.



Epicycloidal Engine.—Top View.

DIAMETRAL PITCH.

In designing spur gearing it is necessary to find the circular pitch, not only because, as we have seen, it is used in the graphic construction, but because the strength of the tooth depends upon its thickness. Were there nothing to the contrary, it would be most convenient to express the pitch in whole numbers or manageable fractions, as 2 inch pitch, $\frac{3}{4}$ inch pitch, and so on. But as the circumference is 3.1416 times the diameter, awkward decimals will often appear in the values of the diameters of the pitch circles, if this plan be adhered to. Now, if the tooth be strong enough, it matters little if it be a little stronger; and it is practically much more important to have the diameter a whole number, or a convenient fraction, than that the circular pitch should be either the one or the other. This is accomplished by the use of what is called the *diametral pitch;* which is simply the quotient found by dividing the diameter, instead of the circumference, into as many equal parts as the wheel has teeth:

$$\text{Whence, Diametral Pitch} = \frac{\text{Diameter}}{\text{No. of Teeth}},$$

and Circular Pitch = Diametral Pitch × 3.1416.

In the use of this system, convenient values of the diametral pitch are selected, each being a fraction with unity for its numerator and an integer for its denominator, as 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{11}$, etc.

The denominators of these fractions only are commonly used in giving the diametral pitch; thus an "8-pitch wheel" is one which has eight teeth for each inch of diameter, or whose diametral pitch is $\frac{1}{8}$". This is, in fact, merely inverting the fraction, and giving the value of $\frac{\text{No. of Teeth}}{\text{Diameter}}$; thus, let a wheel of 16 inches diameter have 80 teeth; then, $\frac{16}{80} = \frac{1}{5}$" = diametral pitch, but $\frac{80}{16} = 5$, and we call it a "5-pitch" wheel. By this system the calculations as to diameter and number of teeth are made very simple; as, for example:

Required, the diameter of a 4-pitch wheel with 37 teeth:

$\frac{37}{4} = 9\frac{1}{4}$ = diameter.

How many teeth of 16-pitch on a wheel of $3\frac{7}{8}$ diameter?

$3\frac{7}{8} \times 16 = 62$ = No. teeth.

The tooth may be made to project outside the pitch circle, a definite fraction of the diametral pitch, as in the case of the circular pitch; and thus the size of the blank may be readily ascertained. If this projection be made, for instance, $1\frac{1}{8}$ the diametral pitch, the face of the tooth will be nearly as long as that found by the first of the arbitrary rules above given; and the diameter of the blank is determined by simply adding to that of the pitch circle, $2\frac{1}{4}$ times the diametral pitch.

THE MANUFACTURE OF ACCURATE GEAR CUTTERS.

In cutting a spur wheel it is essential that the contour of the milling cutter conform precisely to that of the space between two teeth. The obvious disadvantages of turning the cutter by hand to fit a template filed out, if not laid out, by hand, have already been alluded to; also the fact that they have been in part avoided, by the use of mechanical means for describing the required curves on the template.

This is, however, but one step, and that of the shortest; for by the methods explained in our first article, the epicycloidal curves can be drawn on metal with comparative speed and extreme accuracy. There yet remain the laborious processes of making the template, and making the cutter fit it when made. When these things are done by hand, exact duplication of templates, cutters or wheels, is a matter of impossibility, to all practical intents and purposes.

But this becomes, on the contrary, a matter of ease and perfect certainty, when the work is done by the two machines of which we give illustrations. They were recently introduced by the Pratt and Whitney Company, in whose shops they may be seen in successful operation; and they are well worthy of study, not only on account of the ingenuity and beauty of their movements, but as models of skillful planning and rare examples of the practical embodiment of correct theory.

THE EPICYCLOIDAL ENGINE.

The object of this machine is to form the template subsequently used as a guide in

shaping the cutter. Its general appearance is shown in Fig. 1; the operating parts are more distinctly shown in Fig. 2, which is a view taken nearly from above; the action is illustrated in the series of cuts which follow.

In Fig. 3 *A* is a portion of a flat ring, fixed to the framing; this represents a pitch circle. *B*, is a disc, representing the describing circle; this turns freely upon a tubular stud *E*, fixed in the carrier *C*, which turns about a pivot *D*, fixed to the frame at the center of *A*; by means of the clamped socket, capable of sliding upon the rod, the position of *D*, may be adjusted to suit the radius of *A*. Thus as *C* moves, the disc can roll upon the edge of *A*, and is compelled to do so by the flexible steel ribbon shown by the heavy line, which is wrapped round and secured to both pieces, due allowance for its thickness being made in adjusting their radii. *E'* is a second tubular stud fixed in the carrier, at the same distance from the pitch circle as the other, but on the opposite side; the centers of the two studs lying on a right line through *D*. Upon these two studs turn the two worm wheels *F*, *F'*, shown in Fig. 4; these are in a plane above *A* and *B*, so that the axis of the worm *G*, is vertically over the common tangent of the pitch and describing circles; the relative positions of these and other parts will be most clearly seen by a study of the vertical section, Fig. 8. The worm *G*, is supported in bearings secured to the carrier *C*, and is driven by another small worm turned by the pulley *I*, as seen in Fig. 2; the driving cord, passing through suitable guiding pulleys, is kept at uniform tension by a weight, however *C* moves; this is shown in Figs. 1 and 2.

Upon the same studs, in a plane still higher than the worm-wheels, turn the two discs *H*, *H'*, Figs. 5, 6, 7. The diameters of these are equal, and precisely the same as those of the describing circles which they represent, with due allowance, again, for the thickness of the steel ribbon by which these also are connected. It will be understood that each of these discs is secured to the worm wheel below it, and the outer one of these to the disc *B*: so that as the worm *G* turns, *H* and *H'* are rotated in opposite directions, the motion of *H* being identical with that of *B*: this last is a rolling upon the edge of *A*, the carrier *C* with all its attached mechanism moving around *D* at the same time. Ultimately, then, the motions of *H*, *H'*, are those of two equal describing circles rolling in external and internal contact with a fixed pitch circle.

In the edge of each disc a semicircular recess is formed, into which is accurately fitted a cylinder *J*, provided with flanges, between which the discs fit so as to prevent end play: this cylinder is perforated for the passage of the steel ribbon, the sides of the opening, as shown in Fig. 5, having the same curvature as the rims of the discs. Thus when these recesses are opposite each other, as in Fig. 6, the cylinder *J* fills them both, and the tendency of the steel ribbon is to carry it along with *H* when *C* moves to one side of this position, as in Fig. 7, and along with *H'* when *C* moves to the other side, as in Fig. 5.

This action is made positively certain by means of the hooks *K*, *K'*, which catch into recesses formed in the upper flange of *J*, as seen in Fig. 6 The spindles, with which these hooks turn, extend through the hollow studs, and the coiled springs attached to their lower ends, as seen in Fig. 8, urge the hooks in the directions of their points; their motions being limited by stops *o*, *o'*, fixed not in the discs *H*, *H'*, but in projecting collars on the upper ends of the tubular studs. The action will be readily traced by comparing Fig. 6 with Fig. 7; as *C* goes to the left, the hook *K'* is left behind, but the other one, *K* cannot escape from its engagement with the flange of *J*: which accordingly is carried along with *H* by the combined action of the hook and the steel ribbon.

On the top of the upper flange of *J*, is secured a bracket, carrying the bearing of a vertical spindle *L*, whose center line is a prolongation of that of *J* itself. This spindle is driven by the spur wheel *N*, keyed on its upper end, through a flexible train of gearing seen in Fig. 2: at its lower end it carries a small milling cutter *M*, which forms the edge of the template *T*, firmly clamped to the framing.

When the machine is in operation, a heavy weight seen in Fig. 1, acts to move *C* about the pivot *D*, being attached to the carrier by a cord guided by suitably arranged pulleys; this keeps the cutter *M* up to its work, while the spindle *L* is independently driven, and the duty left for the worm *G* to perform, is merely that of controlling the motions of the cutter by the means above described, and regulating their speed.

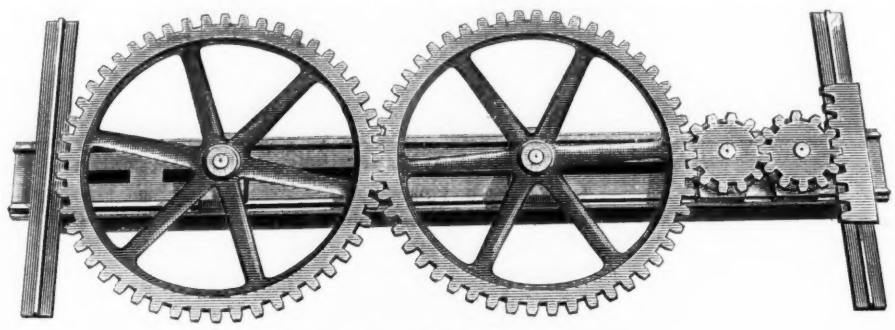


FIG. 14. SET OF WHEELS AND RACK.

The center line of the cutter is thus automatically compelled to travel in the path *RS*, composed of an epicycloid and a hypocycloid, if *A* be a segment of a circle as here shown; or of two cycloids, if *A* be a straight bar. The radius of the cutter being constant, the edge of the template *T* is cut to an outline also composed of two curves; since the radius of *M* is small, this outline closely resembles *RS*: but particular attention is called to the fact that it is *not identical with it, nor yet composed of truly epicycloidal curves of any generation whatever:* the result of which will be subsequently explained.

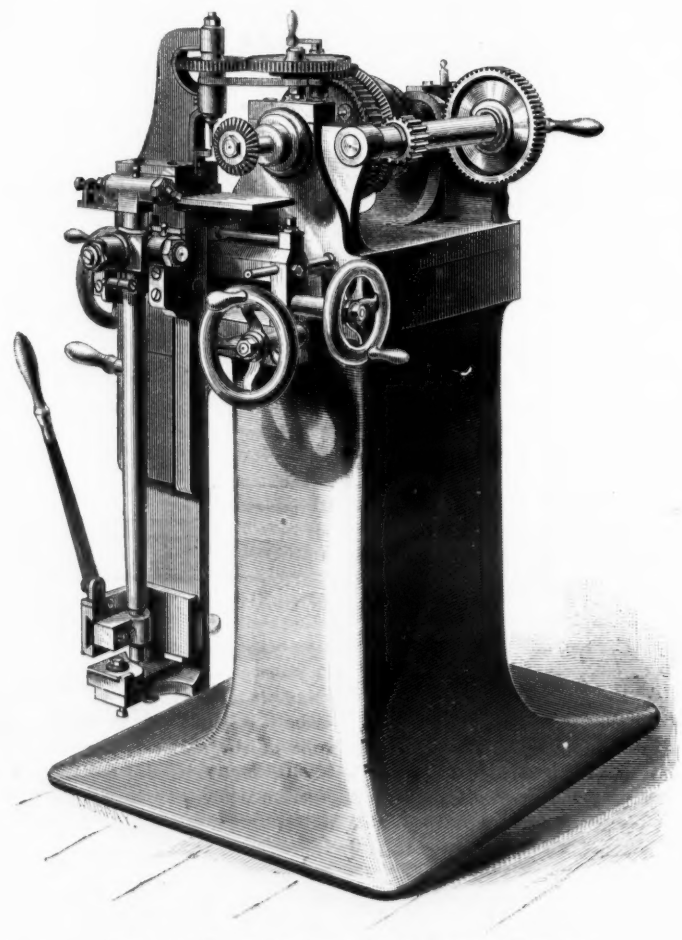


FIG. 11. PANTAGRAPHIC GEAR CUTTER ENGINE.

NUMBER AND SIZES OF TEMPLATES.

With a given pitch, every additional tooth increases the diameter of the wheel, and changes the form of the epicycloid; so that it would appear necessary to have as many different cutters, as there are wheels to be made, of one pitch.

But the proportional increment, and the actual change of form, due to the addition of one tooth, becomes less as the wheel becomes larger; and the alteration in the outline soon becomes imperceptible. Going still farther, we can presently add more teeth without producing a sensible variation in the contour. That is to say, several wheels can be cut with the same cutter, without introducing a perceptible error. It is obvious that this variation in the form is least near the pitch circle, which is the only part of the epicycloid made use of; and Prof. Willis many years ago deduced theoretically, what has since been abundantly proved by practice,—that instead of an infinite number of cutters, 24 are sufficient of one pitch, for making all wheels, from one with 12 teeth up to a rack.

Accordingly, in using the epicycloidal engine, segments of pitch circles are provided of the following diameters (in inches):

12,	18,	27,	60,
13,	19,	30,	75,
14,	20,	34,	100,
15,	21,	38,	150,
16,	23,	43,	300,
17,	25,	50,	∞.

The diameter of the discs which act as describing circles, is $7\frac{1}{2}$ inches, and that of the milling cutter which shapes the edge of the template, is $\frac{1}{8}$ of an inch.

Now if we make a set of 1-pitch wheels with the diameters above given, the smallest will have twelve teeth, and the one with fifteen teeth will have radial flanks. The curves will be the same whatever the pitch; but as shown in Fig. 9, the blank should be adjusted in the epicycloidal engine so that its lower edge shall be $\frac{1}{16}$th of an inch (the radius of the cutter *M*) above the bottom of the space; also its relation to the side of the proposed tooth should be as here shown. And, as previously explained, the depth of the space depends upon the pitch. In the system adopted by the Pratt & Whitney Company, the whole height of the tooth is $2\frac{1}{8}$ times the diametral pitch, the projection outside the pitch circle being just equal to the pitch, so that diameter of blank = diameter of pitch circle + 2 × diametral pitch.

We have now to show, how, from a single set of what may be called 1-pitch templates, complete sets of cutters of the true epicycloidal contour may be made of the same or any less pitch.

THE PANTAGRAPHIC CUTTER ENGINE.

In Fig. 9, the edge *TT*, is shaped by the cutter *M*, whose center travels in the path *RS*, therefore these two lines are at a constant normal distance from each other. Let a roller *P*, of any reasonable diameter, be run along *TT*, its center will trace the line *UV*, which is at a constant normal distance from *TT*, and therefore from *RS*. Let the normal distance between *UV* and *RS* be the radius of another milling cutter *N*, having the same axis as the roller *P*, and carried by it, but in a different plane, as shown in the side view; then whatever *N* cuts will have *RS* for its contour if it lie upon the same side of the cutter as the template.

Now if *TT* be a 1-pitch template above mentioned, it is clear that *N* will correctly shape a cutting edge of a gear cutter for a 1-pitch wheel. The same figure, reduced to half size, would correctly represent the formation of a cutter for a 2-pitch wheel of the same number of teeth; if to quarter size, that of a cutter for a 4-pitch wheel, and so on.

But since the actual size and curvature of the contour thus determined depend upon the dimensions and motion of the cutter *N*, it will be seen that the same result will practically be accomplished if these only be reduced; the size of the template, the diameter and the path of the roller remaining unchanged.

The nature of the means by which this is effected in the Pantagraphic Cutter Engine is illustrated in Fig. 10. The milling cutter *N*, is driven by a flexible train acting upon the wheel *O*; its spindle is carried by the bracket *B*, which can slide from right to left upon the piece *A*, and this, again, is free to slide in the frame *F*. These two motions are in horizontal planes, and perpendicular to each other.

The upper end of the long lever *PC*, is formed into a ball, working in a socket which is fixed to *B*. Over the cylindrical upper part of this lever slides an accurately fitted sleeve *D*, partly spherical externally, and working in a socket which can be clamped at any height on the frame *F*. The lower end *P*, of this lever being accurately turned, corresponds to the roller *P* in Fig. 9, and is moved along the edge of the template *T*, which is fastened in the frame in an invariable position.

By clamping *D* at various heights, the ratio of the lever arms *TD*, *DC*, may be varied at will, and the axis of *N* made to travel in a path similar to that of the axis of *P*, but as many times smaller as we choose; and the diameter of *N* is made less than that of *P* in the same proportion.

The template being on the left of the roller, the cutter to be shaped is placed on the right of *N*, as shown in the plan view at *Z*, because the lever reverses the movement.

This arrangement is not mathematically perfect, by reason of the angular vibration of the lever. This is, however, very small owing to the length of the lever; it might have been compensated for by the introduction of another universal joint, which would practically have introduced an error greater than the one to be obviated, and it has with good judgment been omitted.

The gear cutter is turned nearly to the required form, the notches are cut in it, and the duty of the pantagraphic engine is merely to give the finishing touch to each cutting edge and give it the correct outline. It is obvious that this machine is in no way connected with, or dependent upon, the epicycloidal engine; but by the use of proper templates it will make cutters for any desired form of tooth; and by its aid exact duplicates may be made in any numbers with the greatest facility. Its general appearance is shown in Fig. 11. It will be

noted that the universal joints are not actually of the ball and socket kind, which suggests the explanation, that in Figs. 3–10 inclusive, we have made no attempt to give precise details or proportions, but only to make as clear as we are able to, the principles and mode of action of these remarkably ingenious machines, as well as of the system adopted in using them.

THEORETICAL DEFECTS OF THE SYSTEM.

It forms no part of our plan to represent as perfect that which is not so. And there are one or two facts which at first thought might seem serious objections to the adoption of the epicycloidal system. These are:

1. It is physically impossible to mill out a *concave* cycloid, by any means whatever, because at the pitch line its radius of curvature is zero, and a milling cutter must have a sensible diameter.

2. It is impossible to mill out even a *convex* cycloid or epicycloid, by the means and in the manner above described.

This is on account of a hitherto unnoticed peculiarity of the curve at a constant normal distance from the cycloid. In order to show this clearly, we have in Fig. 12 enormously exaggerated the radius *CD*, of the milling cutter (*M* of Figs. 7 and 8) The outer curve *HL*, evidently, could be milled out by the cutter, whose center travels in the cycloid *CA*; it resembles the cycloid somewhat in form, and presents no remarkable features. But the inner one is quite different; it starts at *D*, and at first goes down, *inside the circle whose radius is CD*, forms a cusp at *E*, then begins to rise, crossing this circle at *G*, and the base line at *F*. It will be seen then that if the center of the cutter travel in the cycloid *AC*, its edge will cut away the part *GED*, leaving the template of the form *OGI*. Now if a roller of the same radius *CD*, be rolled along this edge, its center will travel in the cycloid from *A*, to the point *P*, where a normal from *G*, cuts it; then the roller will turn upon *G* as a fulcrum, and its center will travel from *P*, to *C*, in a circular arc whose radius is *GP=CD*.

That is to say, even a roller of the same size as the original milling cutter, will not retrace completely the cycloidal path in which the cutter traveled.

Now in making a rack template, the cutter, after reaching *C*, travels in the reversed cycloid *CR*, its left-hand edge, therefore, milling out a curve *DK*, similar to *HL*. This curve lies wholly *outside* the circle *DI*, and therefore cuts *OG* at a point between *F* and *G*, but very near to *G*. This point of intersection is marked *S* in Fig. 13, where the actual form of the template *OSK* is shown. The roller which is run along this template is *larger*, as has been explained, than the milling cutter. When the point of contact reaches *S* (which is so near to *G* that they practically coincide), this roller cannot now swing about *S* through an angle so great as *PGC* of Fig. 12; because at the root *D*, the radius of curvature of *DK* is only equal to that of the cutter, and *G* and *S* are so near the root that the curvature of *SK* near the latter point, is greater than that of the roller. Consequently there must be some point *U* in the path of the center of the roller, such that when the center reaches it, the circumference will pass through *S*, and be also tangent to *SK*. Let *T* be the point of tangency; draw *SU* and *TU*, cutting the cycloidal path *AR* in *X* and *Y*. Then, *UY* being the radius of the new milling cutter (corresponding to *N* of Fig. 9) it is clear that in the outline of the gear cutter shaped by it, the circular arc *XY* will be substituted for the true cycloid.

THE SYSTEM PRACTICALLY PERFECT.

The above defects undeniably exist; now, what do they amount to? The diagrams, Figs. 12 and 13, are drawn purposely with these sources of error greatly exaggerated in order to make their nature apparent and their existence sensible. The diameters used in practice, as previously stated, are: describing circle, 7½ inches; cutter for shaping template, ⅛ of an inch; roller used against edge of template, 1⅛ inches; cutter for shaping a 1 pitch gear-cutter, 1 inch.

With these data the writer has found that the *total length* of the arc *XY* of Fig. 13, which appears instead of the cycloid in the outline of a cutter for a 1-pitch rack, is less than 0.0175 inch; the real *deviation* from the true form, obviously, must be much less than that. It need hardly be stated that the effect upon the velocity ratio of an error so minute, and in that part of the contour is so extremely small as to defy detection. And the best proof of the practical perfection of this system of making epicycloidal teeth is found in the smoothness and precision with which the wheels run; a set of them are shown in gear in Fig. 14, the rack gearing as accurately with the largest as with the smallest. To which is to be added, finally, that objection taken, on whatever grounds, to the epicycloidal form of tooth has no bearing upon the method above described of producing duplicate cutters for teeth of any form, which the pantagraphic engine will make with the same facility and exactness, if furnished with the proper templates.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * Contrary to my expectations, his honor, the judge, has not yet decided whether McGuffey must pack up his hideous noises, and his boiler tools, and his water power, and move to other climes, where the patrons of the heavy arts are already deaf. The matter is one of considerable interest to every man who makes an industrial racket within the hearing of the sensitive property owner, and I will post you when a decision is reached.

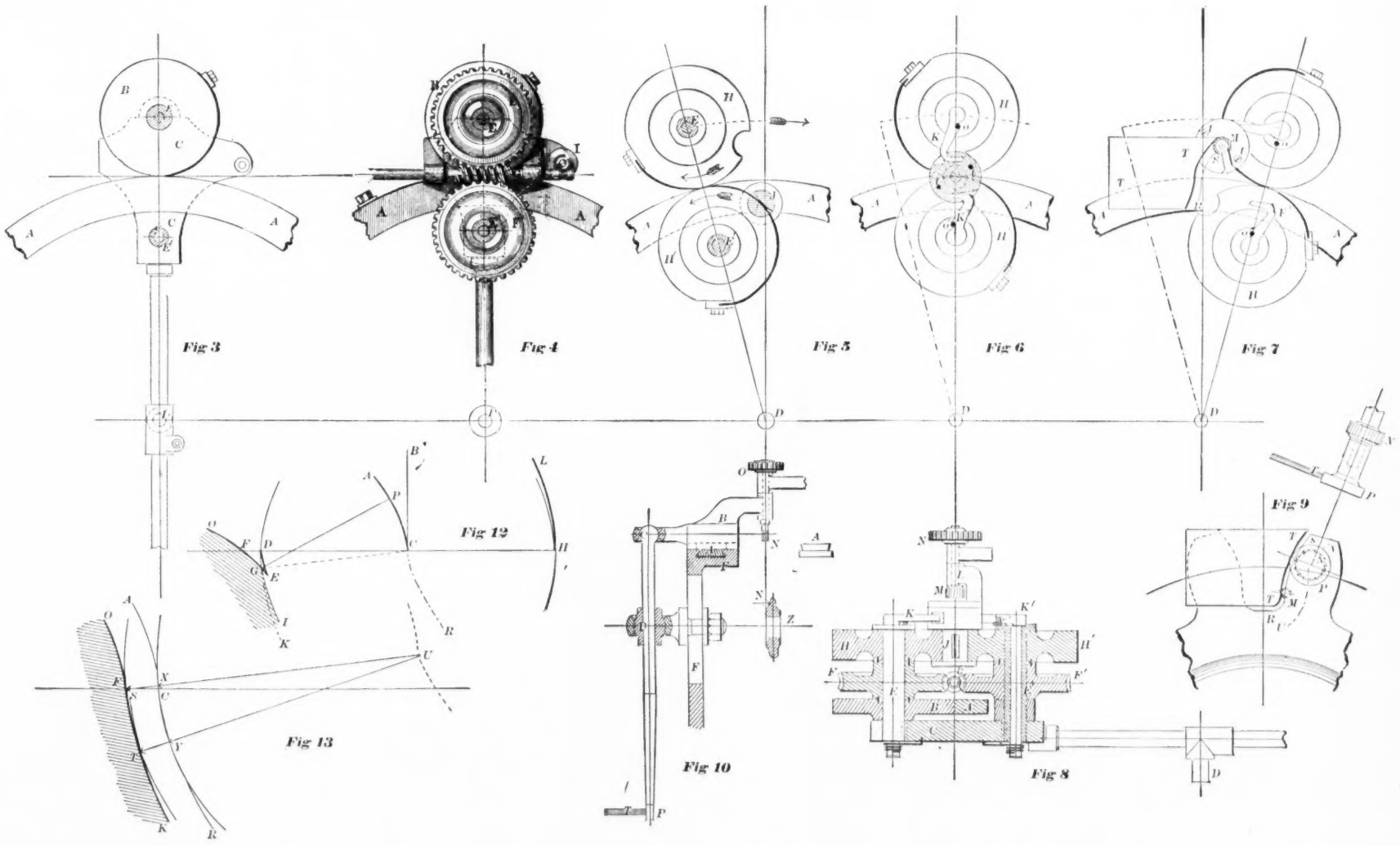
* * * * Some towns full of factories give no thought to their great value as creators and supporters of the place. There are some places of considerable size which seem to be totally unaware of the fact that the pay rolls of the shops are the pay rolls of the town. Many towns, however, are alive to this question and seek, by means wise and unwise, legitimate and illegitimate, prudent and absurd, to get manufacturers to locate among them. They offer choice real estate free of cost, brick for the hauling, water for years free of cost, exemption from taxation for a limited term, free transportation from the old point, free removal of all present facilities, such as coal mines, iron mines, canals, rivers, local trade, etc., and large cash donations or loans. Towns can afford these things. Manufactures bring people, and people who spend every cent they earn. The pay roll of a concern represents the instant expenditures of the employes.

* * * * Newton has had a splendid shop running for about six years. He built it after deliberate planning, and he seems to have almost every modern convenience. His foundry is large and well shaped. Cranes touch the big floor all over. The core oven is the best I have ever seen, and for a wonder, it is in the right place. Sand and iron can be got to the foundry nicely, and castings can get to the cleaning room nicely, and from the cleaning room they can get to the shop or track nicely. Car-tracks, turntables, scales and cranes are just in the right place. The sand sheds are handy, the flask yard is handy, the scrap yard is handy. The blacksmith shop is put where stock can be got to it and where forgings and cinders can be got from it. The pattern shop is located so lumber can be got from the lumber house, and so patterns can be got to the pattern store room, and a trap in the floor lets all shavings and dust down into a fire-proof vault with a single low-down door for cartage. The pattern store room is large and light, and is divided so you can find a pattern in it. The lumber house is well arranged and well ventilated. The paint shop is tip top. The water closets are more than decent. The wareroom, and the store room, and the offices, have all been well looked out for. The machine shop is well arranged for the handling of work without much tugging, and for its easy delivery upon the cars when done. The division of things for fire protection is good, and air, and light, and water are in abundance.

With all these conveniences finely schemed and finely executed, Newton finds he has been guilty of a grand oversight, and he sometimes expresses a wish that the whole shop would tumble down so he could build it over again.

* * * * It is really a fact that Newton has no place to keep castings. His foundry can make them, and his shop can work them up, but in the interim between operations there is not a place where these castings may rightfully lay their heads. There is no place for them in the foundry, the cleaning room is fully occupied by castings being cleaned, and there is no yard-room which is not legitimately and fully occupied. Every manager knows that, while there is no necessity for harboring old useless, out-of-fashion, or cracked castings, many tons of standard work must be kept on hand untouched for many weeks.

Poor Newton now finds that there is only one place to put these castings in, and that is in the machine shop. As a consequence,



he now sees piles and piles of castings wherever he may look. Alongside lathes and planers and drills and slotters and boring mills, and under and on top of lathes, planers, drills, slotters, and boring mills, are these things piled. They hurt the eyeballs of the manager, they annoy the men, they prevent cleaning up the shop, they demoralize things generally.

The place originally planned for a setting up floor is now a trifling space, bounded on all sides by a craggy shore of untouched castings. In the disorder of these castings there is no keeping track of them, and it is almost always easier to get new castings from the foundry than to unearth old ones from these piles. Newton swears he won't put up with it any longer, and is now planning a general confiscation of the pattern store-room as a casting store. He will put another story on the pattern shop to give him a pattern room. He purposes to divide his new casting room, *nee* pattern warehouse, by low fences into small spaces devoted to each separate product he builds, so that castings may be found instanter, and the whole stock kept free and in subjection.

* * * * This reminds me that in Mr. Corliss' shop in Providence, the casting room is made amply large, and is made the focal point of tracks from the foundry and other shops. Here the castings come as soon as done, and here they stay in store till needed.

* * * * And this again reminds me that in some little country shops there is forever and eternally a wrangle over the question of whose business it is to clean up castings. Sometimes the foundry will clean up castings nicely, more to see what the castings look like, than to perform a duty, and sometimes they won't. Sometimes the foundry wants core rods, or anchors, or spiders, or some big core to saw up into little ones, in which case they may clean the casting before they get done with it. Sometimes the cupola tender has time to clean castings, and sometimes he doesn't. Sometimes there will be a gawk of a man employed for the purpose, and the foundry will want this gawk for a shoveler as soon as the castings are shaken out.

* * * * Some lathesman has had orders for a week, to snatch a certain gear as soon as it is cast and "bore her out two and seven-sixteenths full." This morning he is told that the boys managed to get a good one cast last night, so he goes into the foundry and, among a lot of other stuff, he sees a lump of sand which he recognizes as being pregnant with the thing sought for. He kicks the thing around a little, curses it a good deal, jabs some of the sand loose with an old core rod, and puts some finishing touches on it with an old file stub, and then trundles it into the shop, leaving a track of burnt sand wherever he goes. When he gets to his lathe and lets some of it light on his gear, he concludes to take a little more loose sand off. He rattles it off with a hammer. Then he chucks the job, and in knocking it into trueness he gets some more sand off. The lathe catches all the sand removed by this process. Then he bores her out two and seven-sixteenths full, and throws it on the floor. Some viseman cuts a key seat in it, and it is ready for shipping. Not a grain of sand has been purposely removed, which did not in some way interfere with the handling or working of the job. No one has pretended to clean this casting. If this machinist had gone to the foundry-men and said anything about cleaning he would have been told that nobody had time just now. If he had gone to the head boss of the shop, he would have been sent to the foundry-men. If he had stood around that pile of castings, till somebody did have time to clean his job, the aforesaid head boss would have happened in and told him to "clean her up and get her done." Our machinist knows all about this, so he don't say boo to anybody. He takes as little sand off as possible, and gets the job off his hands.

* * * * The worst moulders in this wide world are the moulders who work in these little country shops. Unlike the country machinists, they don't know how to do good work with poor facilities; and, unlike city moulders, they don't know what facilities to ask for. Not one in five of them knows anything about moulding. Not one in a dozen can cast a ten pound sash weight without a two pound shrink in it. Not one in a dozen can cast a straight armed pulley at all.

The foreman of such foundries is generally the loudest mouthed braggart that ever rammed sand. He will brag of the fine shops he has had charge of; he will brag of the difficult castings he has made, when others have failed; he will brag of his superior knowledge of irons, and of sand, and of facings. And still he will turn out castings, day after day, which are not near so good-looking as the pig iron he melts up. They will be warped, and strained, and crooked, and hard beyond all belief; he will use parting sand for facing, and will complacently deliver castings with the sand fused into the outer surface; he can make cores which hot iron will melt, and the hub hole in one of his pulleys will be a vitreous cavity, which no machinist, city born, might ever hope to bore out; he will leave cores out where needed, and put cores in original places; he will put anchors just where they ought not to be, and he will fix core rods and spiders so that they will get welded to the casting; he don't seem to care if a casting runs a pound or ten pounds short, and if it is so bad a case that he can't get it off his hands, he will splice it with hot iron the next heat, instead of making a new one; he will lose one tool out of twenty, and when he gets his ugly castings done, he won't clean them up.

* * * * When I was in Cincinnati, I was told of an old shop, and a big one, in that city, which followed the plan, when they made a new pattern, of making one casting, just to see if the pattern was right. And a Cincinnati pattern maker told me that an inventor came to him once and wanted a pattern made. He asked for a drawing; the inventor said he didn't have any. He asked him to make one, and the inventor said he didn't have the least idea how to make a drawing; he asked him to explain what kind of a pattern he wanted, but the inventor didn't know how to explain anything; he told him to make a model, but the inventor was no mechanic, and couldn't. Then he told him he could do nothing for him, and the inventor went away and came back next day with a piece of an apple whittled into the shape he wanted his pattern made.

* * * * Since I commenced on this letter, his honor the judge has delivered himself. After a thorough overhauling of "modern instances," he decides that the boiler makers must go. He puts no originality into his decision. The existence of the nuisance being admitted by defendants, he sees that the last comer ought to go first. He is guided entirely by preceding decisions which have put annoying factories out of manufacturing towns.

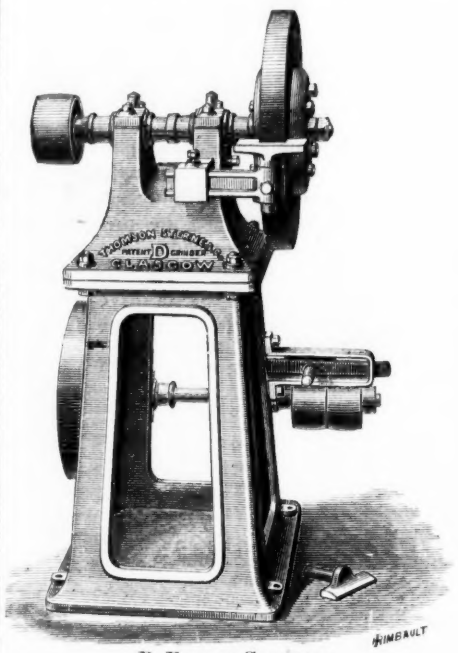
This is a settler for McGuffey. The judge gives him a reasonable time in which to hammer on jobs now under way, and says he can even stay if he will be quiet. He puts the sensitive neighbor under bonds, so that if McGuffey chooses to find out what the Supreme Court thinks of boiler making, and the Supreme Court should say he was erroneously ordered to move, he can find solace in a suit for damages.

McGuffey is now wondering where he can go without annoying somebody.

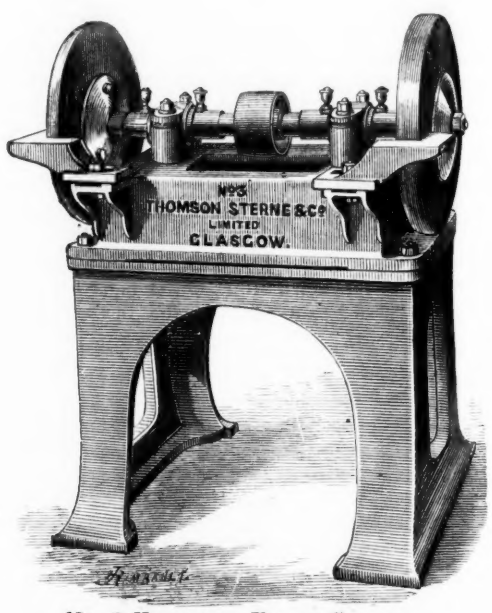
He has received no pressing invitation to come to other parts of the town, though he has received invitations to come to other towns. If he moves at some one's beckoning, I think he will demand from the beckoner the showing of a certificate of absolute deafness, or a bond securing quiet enjoyment of noisy privileges.

* * * * * Very respectfully,

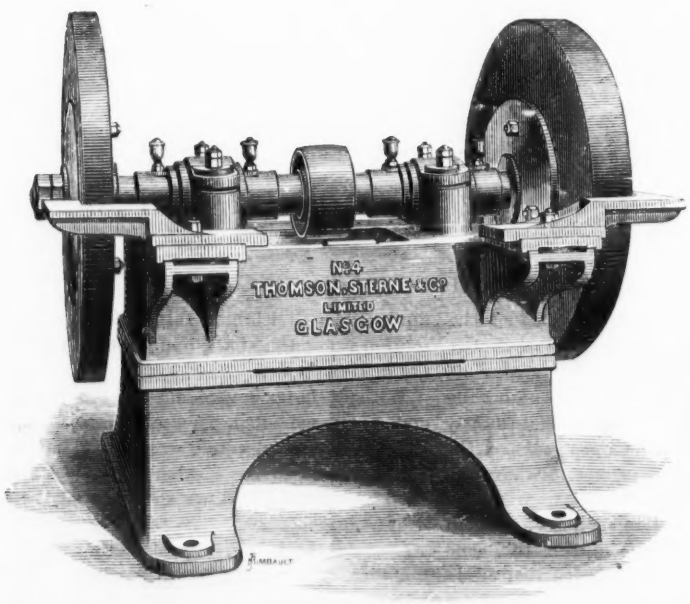
CHORDAL.



D EMERY GRINDER.



NO. 3 UNIVERSAL EMERY GRINDER.



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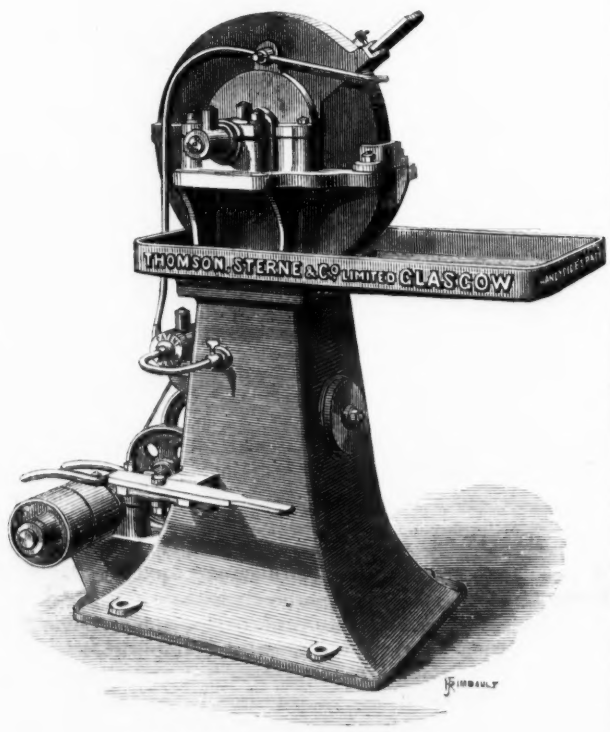


NO. 2 EMERY TOOL GRINDER.

English Emery Grinding Machinery.

Experience has proved that it is almost as important that every fitter should have his own emery wheels and machine as his own vise, so great a saving of time and labor is effected by the use of well-designed and well-constructed tools. We illustrate this week a number of emery grinding machines, now being offered to the British public and users all over the world, by the largest and one of the most enterprising machinery firms in their line in England, namely, Thomson, Sterne & Co., (Limited); offices, 9 Victoria Chambers, Westminster, London, S. W.; 11 Rue Louis le Grand, Paris, France, and factories, the Crown Iron Works, Glasgow, Scotland. We believe the firm has as yet no special representative in this country.

The largest of four Emery Grinders built upon a similar principle is shown in the first illustration, namely their D emery grinder, with stand and counter-gear attached. Of the A, B and C sizes, not shown, it is sufficient to say, that each is ordinarily supplied with a patent "consolidated" emery wheel, 8″ diameter, by 1″ broad, 12″ diam. by 1½″ broad, and 16″ diam. by 1½″ broad, respectively, fitted with cast iron washers, but that special variations from these sizes can be made by special order.

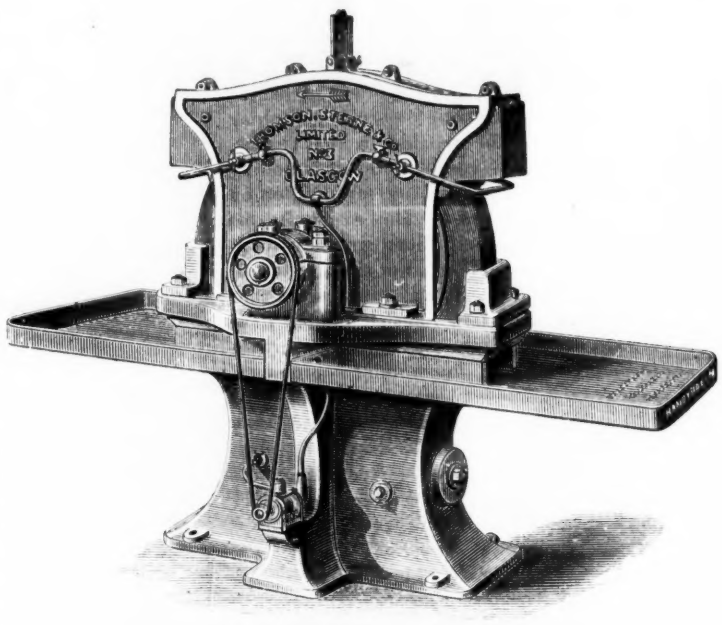
The A, B, C and D grinders are designed so that they can be fixed on a bench and driven by counter gear above or below, but the makers very sensibly recommend that the machines should be supplied with their own stand and counter gear. Two different kinds of rests are supplied with these machines, one being flat, and one angled.

The counter gear being fitted on the stands with belt shifters complete, the grinders are at once ready to be put down to work, only requiring the driving belt from the running shaft of the shop.

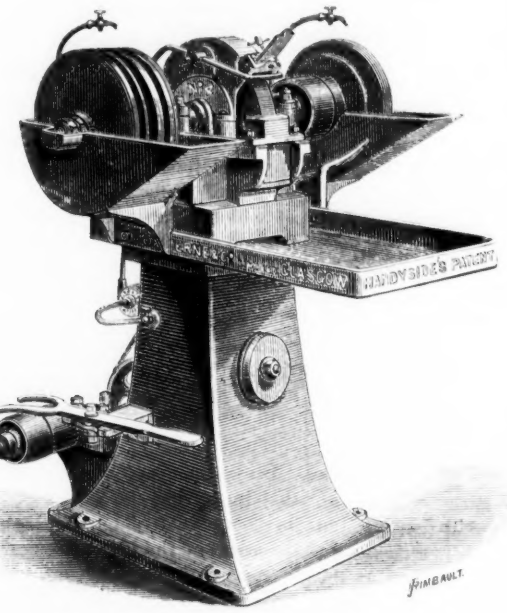
The D emery grinder, shown in the illustration, is fitted with a "consolidated" emery wheel, 20″ diam. by 2″ broad.

The D grinder is a very useful size of machine for general grinding, as a great variety of work both light and heavy can be done on it. These four sizes are all so substantially made, and the emery wheels and washers properly balanced, that they require no expensive foundation, and will run quite satisfactorily on an upper floor, many hundreds being now in successful operation.

Passing to a grinding tool, which is capable of greater variety of applications, we illustrate the two larger (Nos. 3 and 4) of four sizes, known as Nos. 1, 2, 3 and 4 of the universal emery grinders, made by the same firm, they being machines which will be found very useful in all machine shops and foundries. The work may be done on these machines much more quickly and satisfactorily than by files, grindstones or chisels, and in a number of cases a great deal of work can be done that at present costs much valuable time and money by the employment of skilled labor.



No. 3 Emery Tool Grinder.



No. 4 Emery Tool Grinder.

The No. 1 Universal Grinder is supplied with two patent consolidated emery wheels, 12″ diameter; the one 1¼″, and the other ½″ broad.

No. 2 has two wheels, 14″ diameter; the one 1½″, and the other 1″ broad.

No. 3 has two wheels, 20″ diameter; the one 2″, and the other 1″ broad.

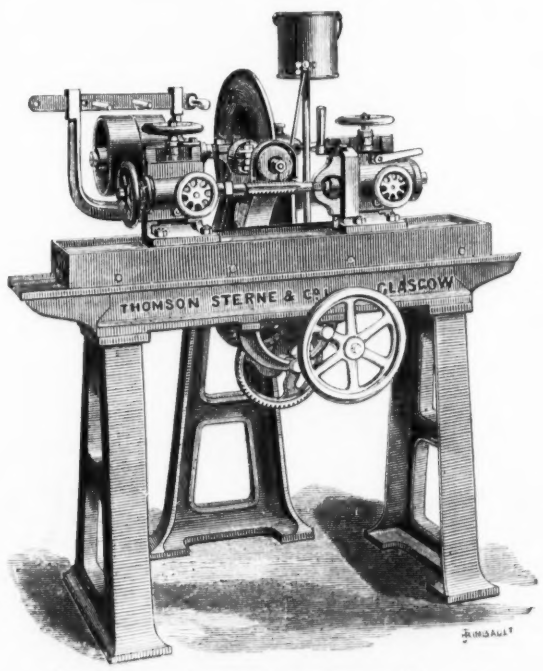
No. 4 has two wheels, 36″ diameter; the one 4″, and the other 2½″ broad. For each of these four sizes, different sized emery wheels may be had by special order.

The bushes of all are cast in special metal, and are of correct proportion to ensure against wearing.

Nos. 1 and 2 machines have their own counter gear in the stand of the machine, with fast and loose pulleys and belt shifter complete. They are all ready to be put down, and only require a belt from the running shaft of the shop. If preferred, the heads of Nos. 1, 2, and 3 universal grinders can be fixed on a bench and driven by counter gear from above or below.

No. 4 machine is designed to grind such articles as require large and heavy emery wheels. These grinders are especially valuable in the work of fettling or dressing castings. This size is driven by a separate counter shaft, which has fast and loose pulleys and belt shifter complete.

Horizontal Emery Grinder.



Emery Tap Groove Sharpening Machine.

We also illustrate the three larger of four sizes of Emery Tool Grinding Machines herewith, which will impart a cutting edge to tools impossible to be attained by the use of grindstones. They are known as Handyside's patent. Tools of any form can be ground on these machines, the consolidated emery wheel being as effective for grinding on the side as on the periphery.

No. 1 tool grinder (not shown) is fitted with a patent "consolidated" emery wheel, 14″ diameter by 2″ broad, and is suitable for grinding light tools.

No. 2 tool grinder has a patent "consolidated" emery wheel 20″ diameter by 2½″ broad, and is suitable for grinding all ordinary sizes of tools.

No. 3 tool grinder is constructed to meet the requirements of large shops using heavy tools, and is arranged so that grinding can be done on front and back of the emery wheel. It is fitted with a patent consolidated emery ring 36″ diameter by 3″ broad.

A special slide rest is provided on the No. 3 grinder, for grinding tools used in tool holders. The No. 3 tool grinder requires a separate counter shaft, which has tight and loose pulleys and belt shifter complete.

The No. 4 tool grinder is constructed especially for the use of joiners, pattern makers and wood workers. It is fitted with six patent consolidated emery wheels, all 12″ diameter, four assorted for gouges, moulding irons, etc., one with square face 2″ broad for plane irons, chisels, etc., and one emery hone to replace water-of-Ayr stone. The center wheel is covered with a cast iron hood, as in the Nos. 1, 2 and 3 tool grinders, which prevents the water escaping. The waste water is caught in the tray, and returns into the water tank in the machines.

Nos. 1, 2 and 4 tool grinders contain their own counter gear, with fast and loose pulleys and belt shifter complete, and all ready to be put down and driven direct from the running shaft of the shop.

To preserve the temper of the tools while being ground, these patent tool grinders are all fitted with a small centrifugal pump attached to the machines, which constantly supplies water to the emery wheel from a tank in the pedestal of the machine.

The horizontal emery grinder, shown in the cut, is constructed to run horizontal emery wheels for grinding dies, etc., and such work as cannot be ground on the periphery of a wheel. It is supplied with a patent consolidated emery ring, 20″ diameter by 2½″ thick, fitted on a suitable cast iron plate. The machine is fitted with guide pulleys for the driving belt, and is driven by a separate counter shaft, fitted with fast and loose pulleys and belt shifter. The entire frame and base of the machine is cast in one piece, and fitted with a loose shield in front which can be removed when access is required to the spindle or bushes, which are all supplied with oil from cups outside of the machine.

The emery tap groove sharpener, shown in the cut, is also Handyside's patent, and is constructed to finish and sharpen screw taps and reamers. It carries a small emery wheel, driven by a disc and friction pulley, and is fitted with fast and loose pulleys and belt shifter, ready to be driven direct from the main shaft. Various thicknesses of emery wheels can be put on to suit the tap or reamer to be sharpened. The tap to be sharpened is held between two adjustable heads mounted upon a table, which is moved forward under the emery wheel by the hand wheel in front, according to the length of the tap or reamer to be ground up to 22″ long. It can also be used for milling brass, by fixing a milling cutter, instead of the emery wheel.

What we have above shown of the emery grinding machinery made by this enterprising firm will suffice, for the present, to show the claims that our English friends make for these tools. In a future issue we shall take occasion to illustrate some further specimens of their work.

Letters from Practical Men.

COAL DUST AS FUEL FOR STEAM BOILERS.

Editor American Machinist:

From the large number of inquiries received by me since writing an article on this subject for the Machinist, it is evident that there is a lack of information on the subject, which I will endeavor to supply as far as I can. It is impossible to lay down rules for the guidance of all cases, so much depends on make and setting of boiler, size of chimney, flue, etc., and last but not least, the brains of the fireman.

One of the first requisites for running a boiler economically with any fuel is a thoughtful, careful and attentive fireman. Much more is this the case with coal dust, as it requires the closest care to produce good results, and in the hands of a careless or ignorant fireman is apt to prove the opposite of a "good thing." Many employers seem to think that any one can fire. Even a prominent M. E. once said to me: "There are too many of you engineers 'about fit to fire,'" thereby intimating that it did not require much skill or intelligence. But I think that nowhere can brains be much better applied than in the management of a boiler furnace, for it is the source of all the power, the engine only utilizing it. One man will burn two tons of fuel and not have as good head of steam as another man will from one ton. Employers do not think enough of this item in their accounts. Right here is another thought. Employers sometimes fit up their boilers with "low-water alarms," "high-pressure alarms," and kindred appliances, and then seem to think that a dollar-a-day man is good enough to have the care of a boiler. Now I think in this way: The most perfect mechanical appliance will not supply the lack of brains in an engineer or fireman. These adjuncts to a steam boiler if not kept in order, are the opposite of safeguards.

My experience with coal dust has been by using a blower to get a powerful draught. I see by a late issue of your paper that a boiler has been set after Mr. Hoffman's ideas in boiler setting (illustrated last year some time), with the Jarvis patent grate. I shall expect to hear great results from that boiler, for I think Mr. Hoffman's ideas are about perfect in that line. I understand that the "Jarvis" grate requires no blower, which is generally a nuisance. I have found by experiment that it is an advantage to have a very deep combustion chamber, so I increased the depth of mine from two feet to four feet or more, with very gratifying results, the boiler seeming to steam as well again. It is important to keep all fire and heating surfaces as free as possible from ashes and soot, and they will require double the care that coal does; the chimney will also need considerable care in this respect. It is also important that the *inside* of boiler be frequently looked to, for with a forced draught (especially if solvents be used to loosen up scale) it is important that the crown sheet especially be kept free from scale or sediment, which seems bound to collect in the spot where it will do most

harm. I leave a bright, clean fire when shutting down at night, simply covering with fresh dust and shutting all dampers. The surface will soon blacken over, and the heat from the walls of furnace and brickwork will hold the steam up all night, still not running it up high enough to blow off at safety valve. I have from 35 to 45 lbs. in the morning, and never have had less than two gauges of water. On starting the blast in the morning, in five to ten minutes I have a bright, hot fire, and steam running up. I frequently keep fire in this way from 6 P.M. Saturday until 5 A.M. Monday, simply putting the blast on a few minutes, Sunday, just to liven it up.

On changing furnace from coal burning to dust burning, I did not increase area of grate surface, but simply reduced area of air space through grate. The grate bars in this furnace have slots 1½ in. long by ⅛ in. wide, placed in rows lengthwise of bar, and 1¼ in. between slots in the row. The grate bar is 5¼ in. wide, and has four rows of air spaces placed "staggering," as it is termed. I think the shape of air spaces of little importance, provided the area is right and is properly distributed. I can use a set of these bars from two and a-half to three years, as the air being forced through them keeps them cool; and they do not burn out, simply warping a little, from ⅛ to ¼ in., always upward. I carry a fire as thick as I can, with gate half shut in blast pipe, and keep steam where I want it; then if all the steam the boiler can make is wanted, thin down fire, give full blast, and I have it. One peculiarity of a dust fire is, that the more it is raked and stirred up, the more steam. If the fire, steam and water are all low, I can, by a judicious raking of the fire, new them all up at the same time, while it would be extremely difficult to do so with coal. I use a four-toothed rake to clean fire with, the teeth being long enough to reach clear through the fire and rest on the grate, leaving the back of rake above and clear of the fire, this, a hoe and a slice bar, being all the tools necessary in handling a dust fire.

I keep the ash pit tightly closed from Monday morning till Saturday night, and force the air from blower into it, and so up through the grate. I only make one-half the usual allowance for expansion with these grate bars, viz.: $\frac{1}{16}$ inch between bars, and one-half inch at the back end, keeping front ends up tight to prevent any air passing up in front of fire. I prefer dust free from lumps of coal, as it burns more evenly, and handles better. With clear dust, I can burn it so clean there will be scarcely anything left, while with coal, it is raked more or less out, or falls through the grate only partially burned, even with careful firing. I consider plenty of boiler room, grate and heating surface, and large area of flues and chimney, a necessity, as it is easy for a careless or ignorant fireman to get up an explosion of gas in the furnace, if the above mentioned areas are small in proportion to grate surface; for if dust is thrown on in large quantities, and full blast put on, it will generate gas faster than it can be utilized, or forced through flues, and, as it must go somewhere, it will go out the furnace doors, to the danger of any one standing in front of furnace. In conclusion, I would say, that having received much interesting and valuable information from your paper, I sincerely hope the little information I am able to give will do *some one* some good. Respectfully yours,

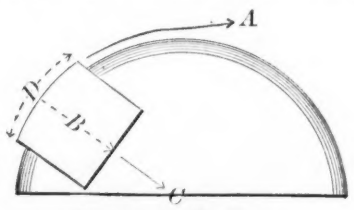
WALTER F. SAGE,
Milford, Conn. *Engineer.*

DRIVING POWER OF BELTS.

Editor American Machinist:

I would call Mr. Lane's attention to the fact that, although there are two pulls on a belt, "one each way," as he states, while the belt is at rest, there is only one pull, or a pull in one direction, when the belt is in motion, transmitting power from one pulley to another. If the arc of contact is infinitely small, as at a point, the area of contact is at the same time a point. If other points be added to increase the length of the arc, they, at the same time, increase the area of contact in precisely the same proportion. What I wish the advocates of the "arc of contact" theory to give me, is some reason why increasing the arc of contact increases the driving power of a belt, which reason shall not apply as directly to the increase of area as to the increase of arc of contact.

Let us now look at this matter in another light. Morin's experiments are held to demonstrate that the friction between two bodies is directly as the pressure, and independent of the surface. Now in all the tables (giving the results of Morin's experiments) that I have seen, no modifications of any kind have been made for any variation of arc of contact; while in every instance of which I have read, or am informed, the friction of surfaces has been governed by the same laws, whether the rubbing surfaces be cylindrical or flat. Am I to understand that the laws of friction for cylindrical surfaces differ from those for plane surfaces, and that for a given weight or pressure the length of the body is an element in the cylindrical surface, but is not in a plane surface?



SPHERICAL PULLEY.

Do you not see, Mr. Editor, that the claim that increasing the arc of contact of a belt increases the driving power, while increasing the *width* of the belt does not, is equivalent to saying that increasing the length of a body influences its friction upon another body, while increasing its width does not?

Suppose, now, we take a circular body, whose radius, as Willis says, is infinite, and its surface, through a length of, say, a foot, is so nearly a plane, that its curve is not distinguishable by mechanical means; or suppose I take a foot of the circumference of a pulley, whose radius is 2,000 miles, and whose width is a foot. I shall then have a surface, say, a foot square, and it will be so near what is known in practice as a true plane, that it will pass for one. Now, these "arc-of-contact" gentlemen, tell me that increasing the length of the plate one way (in the direction of the arc) will increase the driving power of a belt upon it, but increasing it the other way (in the direction of its width will not increase that driving power the weight or pressure remaining, of course, the same in both cases).

Now, Mr. Editor, I have one more little innocent question to put. Suppose I take a spherical pulley, as in the accompanying illustration, and stretch over it a piece of belt, as shown in the cut; the pressure of this belt to the pulley is uniform at, say, one pound per square inch. Will it take any more power to move this belt on the pulley in the direction of *A*, than it will to move it in the direction of *C*? If it does, the friction is not as the pressure, and Morin's laws do not apply, and the direction of motion in connection with an elastic sliding body is an element in determining the friction. If it does not, the arc-of-contact theory is absurd, because the arc of contact is less in the direction of *A*, than in that of *B*, and we will have the same friction, with different arcs of contact and the same area of contact. To make correct the theory that the driving power of a belt increases with the arc of contact, and not with the width, the belt must require more power to move it in the direction of *C*, than in the direction of *A*, because the arc of contact is greater at *C*, than at *A*, and what will then become of Morin's laws and Chordal's "bricks," as applied to belt power? Bear in mind, gentlemen, that this piece of belt is at rest, being pulled first in the direction of *A*, and then in that of *C*. If the theory that the driving power is in proportion to the weight or pressure is correct, it will take the same amount of power to move the belt over the pulley in either direction. If, in consequence of the arc of contact being greatest in the direction of *C*, it takes more power to move the piece in that direction, I shall inform you that the length of the belt is in the direction of *A*, and that *B* is the width of the belt. If it takes more power to move it in the direction of *A*, I shall inform you that *D* is the width of the belt, and *C* the direction of length. Bear also in mind that this piece of belt will not alter the amount of its pressure or friction to the pulley, whether you tell it that you are going to put pieces on it to give it length in the direction of *A*, or of *C*; and, gentlemen, the arc of contact remains constant. JOSHUA ROSE, M. E.

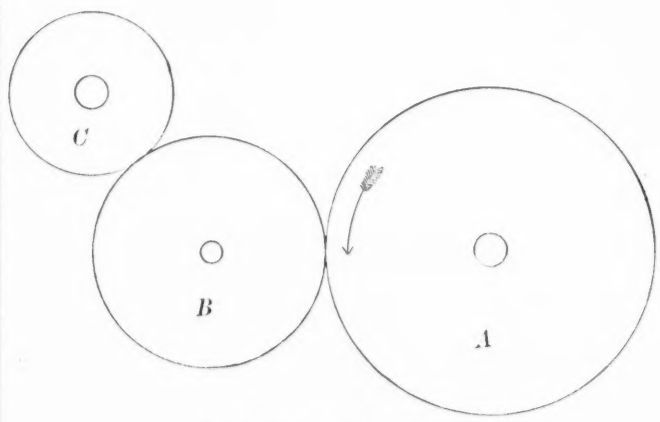
New York.

THAT BARK MILL.

Editor American Machinist:

Since the appearance of my communication of February 28th, I have received from ten different states, fourteen letters, all asking for information about how we got along after making the repairs on that engine, and most of them complaining of pounding in their engines and asking my opinion on each particular cause. But, except in one or two cases, none of them gave any data, from which to make up an opinion. It will be remembered that it was information that I sought in the letter referred to, but I am always willing to give my co-laborers any information that, in my humble opinion, I may possess, and so I wrote to two or three of my enquiring friends, who said they "saw the AMERICAN MACHINIST by accident;" and would have served all in like manner, were it not that I deem your paper the best medium through which to inform all concerned.

Of course no reasonable man would expect one to give the "cause of pounding" in each particular engine, any more than he would expect a physician to prescribe for a patient a hundred miles distant, and of whose disease he knew nothing whatever, except that he was sick. But I can give some few points, in addition to those already mentioned in the AMERICAN MACHINIST,



GEARING FOR BARK MILL.

concerning our own troubles and how they were remedied. Besides all the other difficulties enumerated, it was found that the crank was not square with the shaft, by $\frac{3}{32}$ inch, and that the cylinder was out of plumb by $\frac{3}{16}$ inch, having followed the inclination of the building. Now as to "how we got along after we started up." You will remember I predicted that it was "a question of (very short) time when the whole thing would be back where it was, * * * owing to those gear-wheeels." I then recommended them to be connected indirectly, if used at all—which was not a necessity. The recommendation, however, was disregarded, as was also that of the able machinist who made the repairs. This "extreme parsimony," as one of your editorials of April 10th well puts it, cost the employers, in this instance, about $2,000 for general repairs in the shop, such as a new fly-wheel, new governor, new throttle valve, and several sections of four inch steam pipe, to say nothing of the loss of time in their business. The statement that "every variation in the bark mill was felt directly by the engine" was verified as follows: We were running a 12 foot fly-wheel, 75 revolutions per minute; the bark mill became clogged, there was no give to the gear wheels, so they stopped; but the fly wheel, from its momentum, kept going, and chewed the steel shaft off the whole length of the spline, about 7½ inches around, tore itself all to pieces, and flew partly into space and partly on the governor.

Then the gear wheels were taken out, and all machinery thereafter was driven by belting from the fly-wheel to a counter shaft. As three or four of my correspondents wished to know how many wheels there were, and how they were connected, I send sketch of their relative position.

A, 7 feet in diameter, was on the engine shaft, running as the arrow indicates. *B* was an intermediate, and *C*, 3½ feet in diameter, was on the bark mill shaft, and the main gear was so arranged that it could be thrown out of action when desired. It will be seen that the wheel on the engine shaft running downwards would naturally tend to pounding, by the shaft rising out of its bearings to the extent of the play in the boxes. This is why one engine pounded. If the above should be of any service to the MACHINIST, or its readers, it will amply repay the labor of Yours truly,

Salem, O. M. A. CHAMBERS.

Claims for discoveries of gold mines in the Adirondack region are filed almost daily in the Secretary of State's office in Albany. It may be that many interested persons are victims of a delusion, but it is certain that they believe that a new El Dorado exists in Northern New York.

It is stated that improvements in the manufacture of paper boxes have been introduced lately in Boston, by which they are manufactured directly from the paper pulp. The boxes are turned out of any size or shape, perfectly seamless, and of uniform thickness. After drying, the boxes are run through a second machine at the rate of 60 per minute, receiving, under a pressure of 4,000 pounds, such embossing as may be necessary. From the time the paper stock is taken from the bales until the perfect box is turned from the machine, manual labor is entirely avoided. By the use of one set of these machines 30,000 boxes can be produced per day, at less than one-third of the lowest market price of hand-made goods, and doing the work of 200 hands.

The Westinghouse Air-Brake Company have a patent for manufacturing gas by passing compressed air through a vessel containing sponges saturated with gasoline. It gives a brilliant, pure, white light, making common gas-light look yellow and gloomy in comparison; at the same time it does not blind a person as the electric light does. The gas can be furnished at 60 cents per 1,000 cubic feet.—*Boston Commercial Bulletin.*

The Swiss Industrial Union, keenly alive to the advantages of the system, and yet fearing a little for it, have offered prizes for the solution of the following questions—questions which ought to be considered by our own manufacturers and master mechanics—1. What are the causes of the present unsatisfactory condition of the system of apprenticeship? 2. What are the necessary consequences of this condition? 3. By what ways and means can the system of apprenticeship be organized so as to be made more fruitful to trade at large?

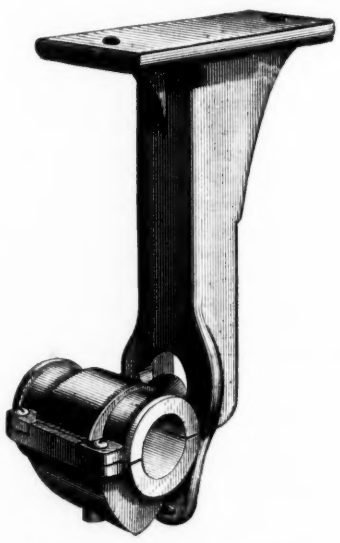
A fire in Chicago, July 30th, damaged to the extent of $15,000 the building used by the U. S. Rolling Stock Co. as a blacksmith and machine shop. It was fully insured.

Fisher's Shafting Hanger.

The transmission of power by belting, having in this country to so great an extent superseded gearing, one of the most important duties that comes within the scope of the engineering profession is to attend to the proper adjustment of shafting, hangers and journal boxes.

The Fisher patent hanger, illustrated herewith, seems to possess some specially valuable points, among which are: interchangeability, the same box answering equally well for drop-hanger or post-bracket; and self-adjustment. The box is connected to the hanger by a dove-tailed trunnion, opposite the center of the journal, and a bolt passing through a slotted hole near the bottom of the drop, thus permitting sufficient movement of the box to adjust itself to a perfect bearing when the shaft is laid in place. After adjustment, the bolt is tightened and the box is as secure as if cast in the hanger.

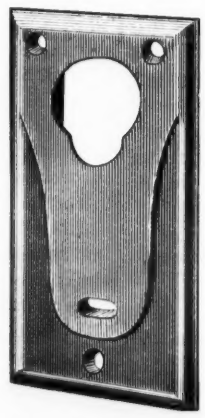
This hanger can be very conveniently and speedily erected, as the front suspending bolt hole is placed vertically over the center of the journal, in order that the bolt may serve as a pivot and not cause the journal box to be thrown out of line when adjusting the back or slotted end. By this means, a line drawn across the foot-blocks, vertically above the proposed shaft will serve as a center line for the front suspending bolt holes.



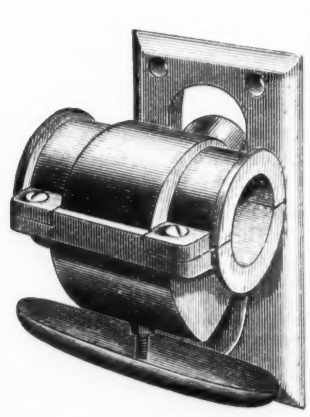
FISHER'S SHAFTING HANGER.

HANGER WITH BOX DETACHED.

BEARING FOR BRACKET.



POST BRACKET.



BRACKET WITH BEARING.

For lubrication, the oil is fed to the journal by capillary attraction, through a wick passing under the cap and resting on the top of the shaft. The wick comes from an "oil cellar" immediately under the box, and part of the same casting. For a three-inch shaft, this "cellar" should contain a pint of oil. This arrangement has been known to lubricate and keep cool a shaft running 120 revolutions per minute, ten hours a day, for twelve months with once filling.

A peculiar arrangement of the pattern enables the moulder to easily adjust it to any length of drop, from ten to eighteen inches.

This hanger is the invention of George W. Fisher, superintendent of the Fulton Iron Works, St. Louis, Mo., who, we understand, is desirous of disposing of his patent to parties who will manufacture them.

It is said that on English railways, switch padlocks are never used. The switches are so constructed that they lock themselves. The handle of the lever, by which the switch is opened, is weighted, and when it is let go the switch returns to its original position. It is thus impossible to have a misplaced switch on the main line, unless the switch were purposely opened, and even then, the chances are that the locomotive would push aside the obstruction. The moment a person who opens a switch leaves it, the rails close again. To back into a siding, the wheels of the locomotive open the switch, and when the train has passed, the switch closes.

The annual exhibition of the American Institute, of the City of New York, will open September 15th. The Board of Managers announce a novel exhibition of the work of amateurs and apprentices in the various branches of mechanical, industrial and decorative art.

The United States government printing office has just completed a book descriptive of machinery used for deep-sea soundings.

Some of the French journals give very flattering accounts of the progress of the preliminary work on the tunnel which is to connect France and England. It is stated that the shaft is sunk to the stratum in which the tunnel is to be cut, and that those engaged in the work are about to sink another shaft, and to lower the machinery for boring under the channel. The work on the tunnel is expected to be finished in two or three years.

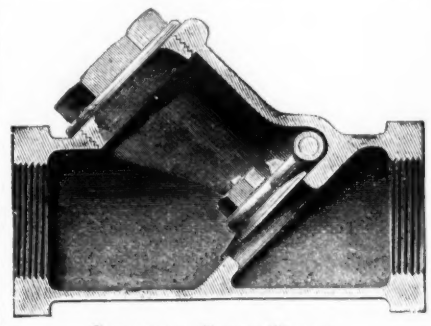
They are building a novel locomotive at the Concord Railroad repair shop, Concord, N. H., says the Boston *Commercial Bulletin*. The boiler, instead of being round, is flat—some 2 feet thick by about 7 wide and 12 long—the tubes running horizontally. This boiler rests over the fire box and in the middle of the locomotive; the engineer's position being in a little cab, similar to the wheelhouse on a steamer, at the forward end; while the fireman's position is at the opposite end, as now, the whole "machine" being considerably longer than the largest used at present. The inventor is a young man by the name of Stevens, whose name this novel locomotive will bear. The greatest idea is the economy of fuel.

Welding Cast Steel.

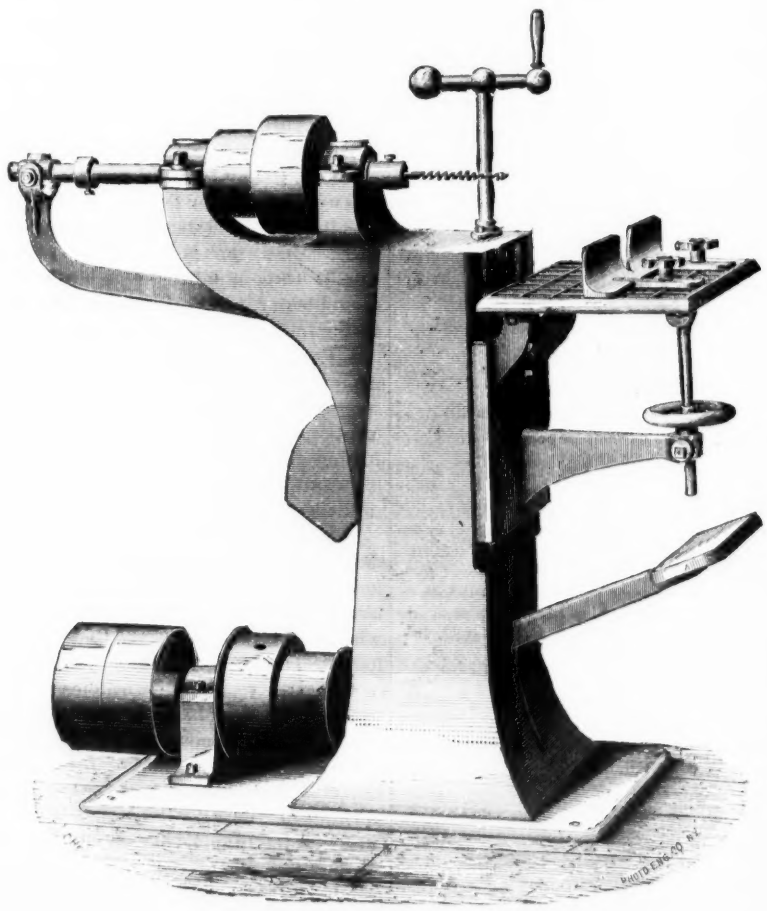
Two points must be taken into consideration chiefly in effecting the welding of steel: It is necessary to render the film of oxidized metal on the surfaces to be united by welding, as fluid as possible, and some means must be found to restore to the steel the carbon eliminated during the process of heating to the welding temperature. According to the *Revue Industrielle*, M. Rust considers boric acid the most effectual in performing the former, and ferrocyanide of potassium in doing the latter. M. Rust considers the functions of the ferrocyanide to be also to restore to the steel nitrogen, upon which he looks as an important constituent of the metal. In 1850 a workman of Mulhouse, Alsace, sold the following receipt for a welding compound: 64 parts of borax, 20 parts of salammoniac, 10 parts of ferrocyanide of potassium, and 5 parts of colophonium. M. Rust changed it as follows: 61 parts of borax, 17¼ parts of salammoniac, 16¾ parts of ferrocyanide, and 5 parts of colophonium. He states that with the acid of this compound, welding may be accomplished at a yellow red, or at a temperature between the yellow red and white, and that no treatment is necessary after welding. The borax and salammoniac are powdered, mixed, and slowly heated until they melt. Heating is continued until the strong odor of ammonia ceases almost entirely, a small quantity of water being added to make up for that lost by evaporation. The powdered ferrocyanide is then added, together with the colophonium, and the heating is continued until a slight smell of cyanogen is noticed. The mixture is allowed to cool by spreading it out in a thin layer. During the process given, boric acid and chloride of sodium are formed, ammonia being expelled. The same product may, therefore, be obtained by mixing 41.5 parts of boric acid, 35 parts dry chloride of sodium or salt, 15.5 to 26.7 parts of ferrocyanide of potassium, 7.6 parts of colophonium, and 3 to 5 parts of dry carbonate of soda. The only trouble with this mixture, which gives the same results, is that it decomposes easily, unless it is kept in a dry place.

A Swinging Check-Valve.

The difficulty generally experienced with ordinary check-valves, using the stem and guide, is that the stem will sometimes expand—when used for steam—and the disk cannot fall on its seat. If the stem were made smaller it would be loose, and the disk could not properly seat itself. The swinging check-valve, illustrated herewith, is designed to avoid all difficulties of unequal expansion and contraction. The clapper swings loosely on the pin, driven through the valve, and the disk, being loose on the clapper, may seat itself true. As the disk is made separately, it can be ground in, the same as other valves. The valve is straight-way, and can be used either horizontally or vertically, delivering very rapidly in either position. This valve is one of the steam users' specialties offered by A. Aller, 109 Liberty street, New York.



SWINGING CHECK-VALVE.



HORIZONTAL BORING MACHINE.

Universal Horizontal Boring Machine.

The accompanying engraving represents a new universal horizontal wood boring machine, manufactured by C. B. Rogers & Co., Norwich, Conn. It is adapted to a great variety of work, as will be seen from the number of different adjustments of which it is capable. The bed for work, shown at the right, is gibbed to the columns and is moved upward and downward by a screw operated by the handle at the top. It also has two angular adjustments, one by means of the screw and wheel underneath, and the other by means of gauge slides on the table. The bit shaft is forced forward with the desired speed by a jointed treadle. This machine has a countershaft, with a cone of two changes, bolted to its base, thus making it very compact and easily located in the shop. Its weight is about 500 pounds. The material of construction is wholly iron and steel.

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NEW YORK, AUGUST 21, 1880.

CONTENTS.

PAGE.

The Teeth of Spur Wheels.—Their Correct Formation in Theory and Practice. No. 3. Prof. C. W. MacCord 1
Extracts from Chordal's Letters 3
English Emery Grinding Machinery 4
Letters from Practical Men 6
Fisher's Shafting Hanger 7
Welding Cast Steel 7
A Swinging Check Valve 7
Universal Horizontal Boring Machine 7
Slow Progress at the Hudson River Tunnel 8
Mistakes in Mechanical Advice 8
Ice and Iron 8
Tribulations of Mechanical Instructors 8
Awards at the Sydney Exhibition 9
Questions and Answers 9
Manufactures 9
Machinists' and Engineers' Supplies 10
Iron Review 10
Metal Review 10

Slow Progress at the Hudson River Tunnel.

Since the disaster, which was described in our issue of August 7, 1880, the work of gaining access to the bodies still buried in the tunnel has progressed at a remarkably slow rate. While the Tunnel Company and the engineers in charge of the work may have done all that they thought possible to push the work forward, some steps have been taken which will bear criticism. In the course of the first day's proceedings, two large timbers were placed across the top of the shaft from which to suspend a frame to which a pump and small engine were attached. Through the stupidity of a workman, *there being no competent overseer on the spot at the time*, the pump was knocked from the frame, and sank to the bottom of the shaft. Owing to this accident work was suspended for the night. On the following morning a diver was procured who succeeded in securing the pump, which was then put in position, and a connection made with the boiler by means of a flexible hose.

The attempt to pump out the shaft with a single pump of the nominal capacity of 1,200 gallons per minute was a blunder, as there was abundant evidence to show that, at the time of the disaster, the water poured in at not less than three or four times this rate. Nor was the method pursued less faulty in details than the general plan. Owing to the lack of an outside bearing on the spindle of the pump (a fault which could have been remedied in an hour's time), the heavy strain of the belt upon the pulley caused an excessive friction upon the single bearing, resulting in a hot journal, a diminished rate of speed, and a subsequent stoppage of the whole machinery.

As a further illustration of the want of intelligent management shown in these proceedings, it may be noted that a new spindle was next sent for, on the supposition that the spindle in use was bent, causing a delay of many hours, the fact being that the new spindle thus supplied in no wise remedied the difficulty, the real cause of trouble consisting in the lack of sufficient bearings.

Afterward, on account of the unstable manner in which the pump and engine were suspended in the shaft (the difficulty above mentioned remaining still unremedied), a further diminution of speed was the inevitable result, reducing the capacity of the pump to little more than half its nominal duty.

In addition to the foregoing blunders of detail (and others which time and space will not permit us to mention here), the whole idea of pumping the water from the shaft, without first stopping the holes in the air lock, was a gigantic blunder, causing days of delay. Even if the workmen succeeded in clearing the shaft by the means first adopted, the enormous pressure of the incoming water, and the weight of the debris and fallen timber, would have prevented the opening of the door leading from the air lock into the tunnel. The bodies of the entombed men would still have been as inaccessible as before.

The rapidity with which the tunnel and shaft filled with water, and the immense volume of the water which had to be removed, should have convinced competent engineers *in the start*, of the impracticability of any plan which did not employ either a water-tight crib or a caisson. Instead of these, the doubtful experiment of driving down rectangular timbers, with the view of making a coffer-dam, was resolved upon, leaving out of the account the practical certainty of a heavy leakage of water, owing to the impossibility of driving timbers straight under such circumstances.

The same tendency to blunders of detail was shown in this part of the work. Nominally, the engine was placed in charge of one man, but the man thus placed in charge was not an experienced engineer; really the engine was dabbled with by several of the "handy men" employed upon the pile-driving work. As a result, the engine soon broke down, causing additional loss of time by stoppage and repair.

After the completion of the coffer-dam, another delay was caused by the pulling out from the ground of one of the posts to which the guy of the hoisting derrick was attached. By this mishap a number of the bystanders barely escaped serious injury. Investigation showed that this post had only extended into the ground about one foot. The overseer in charge of the work did not know who put the post down, and supposed it had extended to a depth of at least four feet.

In a word, the many delays of the past two weeks have been mainly due to the want of intelligent direction. Neither the stupidity of workmen employed on low wages, nor the deficiencies of the machinery selected for the purpose, can be considered a sufficient excuse. Good pumps are to be had in abundance, and day laborers cannot be expected to display to any appreciable extent, either good judgment or engineering skill. Until both of these qualities are supplied by the Tunnel Company it is useless to venture predictions regarding either the recovery of the bodies of the entombed laborers, or the successful resumption of work upon the tunnel.

Mistakes in Mechanical Advice.

In regarding some editorial remarks in one of our exchanges upon railroad emergencies, a short time since, we were very much surprised to find considerable matter in the shape of advice to the enginemen, much of which was very erroneous, and would have a tendency to mislead, if the directions given were by the reader carried out in practice. The emergencies which the engineman is generally called upon to provide for are various; the most common, probably, is the breaking of crank-pins.

In reference to the course to be pursued in case of a broken crank-pin, the writer of the article referred to says: "Where only one crank-pin is broken, remove the parallel or coupling rods on both sides of the engine, and if the crank-pin belongs to the driving-wheels, remove the connecting rod at the same time; open the cylinder cocks and securely block the cross head. If the parallel rods on both sides of the engine are not removed there is imminent danger, while running, of breaking the remaining crank-pins on the opposite side." The breaking of rods and crank-pins is an accident that frequently happens to locomotives at the present day, therefore it is of the greatest importance for engine men to know how to proceed in case of such an emergency. It is the prevailing opinion in some localities that practical subjects cannot be properly dealt with by newspapers, and the information given in so plain a manner as to be of service to the practical engineer and mechanic. We judge this to be the case from the following extract which we clip from an exchange:

"The management of marine engines, care of the valves, feed pumps, blowing-off, precautions against accident, &c., form an appropriate topic just now, but if engineers must go to the newspapers for this sort of information, they may as well quit the profession."

It has been, and will continue to be, the object of the AMERICAN MACHINIST to be plain, and of direct and positive value in all practical subjects pertaining to mechanical pursuits. The author of the article on railroad emergencies does not mention which crank-pin is referred to as breaking, and his description seems to convey the idea that there are other crank-pins besides those attached to the driving-wheels, and the position in which the cross head should be left is not mentioned. Neither is the necessity of disconnecting the valve rod.

The following directions are practicable, and have been used often upon a lococomotive when a crank-pin or rod had broken: When a crank-pin in the back driving wheel breaks, it generally results in the loss of the parallel rod upon that side where the pin has broken, and unless the engineer is upon the alert, and closes the throttle immediately, the sudden shock may cause the parallel rod upon the opposite side to double up and break. When one or both of the parallel rods are broken, the engine may be run with safety, by removing the fragments that may be attached to the crank-pin. When a main crank-pin breaks, it generally strips one side of the engine. In that case, the fragments of the rods are to be removed, the piston pushed to the front end of the cylinder, and two good blocks of wood placed between the guides. The ends of these blocks should be driven tightly between the guide blocks and cross head, so that there can be no motion.

To prevent the blocks from shaking out, they should be secured by pieces of bell cord. The valve stem should be disconnected, which may be done either by removing the pin through the rock arm, or by separating the stem from the rod. Then suspend the end of the rod by means of a rope. The valve should then be placed upon the center of the seat, so as to cover all the ports, then tighten the stuffing box so as to hold the valve stem from moving, and leave the cylinder cocks open. In this condition, the engine may be worked, using only one side, care being taken not to allow the crank to stop upon the dead center. It is not necessary to disconnect the eccentric rods under these circumstances.

A little good judgment and common sense are the most necessary requisites for a locomotive engineer.

Ice and Iron.

The ice men in this city are repeating the grievous error of judgment from which the iron manufacturers of this country are now suffering. The latter, taking advantage of a material increase of business, pushed their prices to a figure which flooded our markets with foreign iron, and displaced American with British brands to an extent that it will take years to recover from. The ice men, owing to a temporary necessity of changing their base of supply, have fixed the idea of extortion firmly in the mind of every purchaser, and hastened the inevitable advent of the coming ice machine ten years. The mechanical engineer and student of physical science of to-day may find in the artificial manufacture of ice a most inviting field for their energies.

Tribulations of Mechanical Instructors.

At its best, the lot of the teacher, like that of the traditional guardian of the public peace, is usually the reverse of a happy one. In most branches of knowledge instruction is, in a great degree, theoretical. But the mechanical instructor, in order to be successful, must be in some respects more practical than the practical man, while a master of theory among theorists; for, of all theorists, ambitious students are the most theoretical.

The foreman of a shop in active business can usually depend in great measure upon having lathesmen who know how to run a lathe, and visemen who began their shop life as boys working at cleaning castings, and know something practically, if imperfectly, of the tools with which they work, but the teacher of mechanics must begin with beginners at the beginning.

Then, too, the hard, matter-of-fact, earnest atmosphere of work and money-getting that pervades the shop of to-day, finds a poor parallel in the atmosphere of preparation and outlook with which the mechanical instructor has to deal. Ordinarily, the work of instruction must come, almost wholly, from the teacher himself, too often working without coadjutors or assistants, and more often poorly equipped and illy paid.

The skepticism that prevails among less advanced students, who have had some previous shop experience in a small way, as to the value of the instructions offered by older students, usually induces them to require too much detailed instruction from the teacher. The teacher who is new to his place and duties, must contend with almost an equal skepticism regarding himself, not only from the raw students who have had some experience in other shops, but from the older students who have had experi-

ence with his predecessor. The tribulations of the mechanical instructor, who finds himself regarded as a mere theorist by many of his students, are only equaled by those of the instructor whose extremely practical methods are oftentimes distasteful to the advanced students in physics and the higher mathematics.

In some schools, trustees and faculty interest themselves too ardently in the management of the mechanical department, and embarrass the teacher, by lessening his influence with his classes. In others the exact reverse of this difficulty is experienced. In the latter case, Latin and Greek carry more weight than lathes and planers.

Sometimes red tape proves a fruitful source of embarrassment to the earnest mechanical instructor. The teacher who knows what he wishes to teach, and needs a five-legged lathe to teach it with, if considered competent for his place, should have a five-legged lathe. If orders for supplies, needed in the mechanical department must be repeated, duplicated and countersigned by half-a-dozen different officials, with good intentions, but no knowledge of machinery, the tools finally furnished will seldom correspond with the original order. Too often the equipments, imperatively necessary for the work of the instructing shop, are reduced in amount and value, either from lack of means or from unwise discrimination in favor of other departments.

Even in some of our most pretentious educational institutions, membership in the faculty is evidently intended to console the recipient for the meagreness of his salary. When to this is added the special difficulties that frequently beset the mechanical instructor, his plight is sad indeed.

Awards at the Sydney Exhibition.

From the report made to the Secretary of State at Washington, we take the following summary of awards made to exhibitors in the machinery line and branches kindred thereto, at this important exhibition. In all, there were 223 exhibitors from this country, and 288 awards were made to them. The relative order of merit of the awards is, first degree of merit (special); first degree of merit; highly commended, commended, and honorably mentioned.

FIRST DEGREE OF MERIT (SPECIAL).

Henry Disston & Sons, Philadelphia.
R. Hoe & Co., New York. Two special awards.
Fairbanks & Co., St. Johnsbury, Vt.
Edgemoor Iron Co., Wilmington, Del.
J. A. Fay & Co., Cincinnati.
Davis Sewing Machine Co., Watertown.
Winchester Repeating Arms Company, New Haven. Small silver medal.
Whittier Machine Co., Boston. A large silver medal given.
Wm. Sellers & Co., Philadelphia.

FIRST DEGREE OF MERIT.

F. S. Pease, Buffalo.
Silver Lake Co., Boston.
Howe Scale Co., Rutland, Vt.
Wm. Sellers & Co., Philadelphia.
Althouse Windmill Co., San Francisco.
Stanley Rule and Level Co., New Britain, Ct.
Stow Flexible Shaft Co., Philadelphia.
Geo. F. Blake Manufacturing Co., Boston.
Eclipse Windmill Co., Beloit, Wis.
Rumsey & Co., Seneca Falls.
Graham, Emlen & Passmore, Philadelphia.
D. M. Osborne & Co., New York. Two awards.
Wayne Agricultural Co., Richmond, Ind.
Walter A. Wood Mowing and Reaping Machine Co., New York.
Yale Lock Manufacturing Co., Stamford, Conn.
Fairbanks & Co., St. Johnsbury, Vt.
E. M. Boynton, New York. Two awards.
Chas. B. Hardick, Brooklyn, N. Y.

HIGHLY COMMENDED.

H. W. Johns Manufacturing Co., New York.
Hoopes & Townsend, Philadelphia.
Washburn & Moen Manufacturing Co., Worcester, Mass.
Seth Thomas Clock Co., Thomaston, Conn.
Ingersoll Rock Drill Co., New York.
Battle Creek Machine Co., Battle Creek, Mich.
Boston Blower Co., Boston.
Rowley & Hermance, Williamsport, Pa.
The Tanite Co., Stroudsburgh, Pa.
S. A. Wood's Machine Co., Boston.
Oscillating Pump Co., Philadelphia.
Kewanee Manufacturing Co., Kewanee, Ill.
Rumsey & Co., Seneca Falls, N. Y.
Carr & Hobson, New York.
Chadborn & Caldwell Manufacturing Co., Newburgh, N. Y.
Charter Oak Lawn Mower Co., Hartford, Ct.
Johnston Harvester Co., New York.

COMMENDED.

C. B. Rogers & Co., New York.
H. B. Smith Machine Co., Smithville, N.J.
Trump Bros. Machine Co., Wilmington, Del.
Wetherby, Rugg & Richardson, Worcester, Mass.
Carr & Hobson, New York. Two awards.
John Deere & Co., Moline, Ill.
C. H. & L. J. McCormick, Chicago.
Walter A. Wood Mowing & Reaping Machine Co., New York.

HONORABLY MENTIONED.

Furst & Pryibil, New York.
Wiley & Russell Manufacturing Co., Greenfield, Mass.
R. Hoe & Co., New York.
Pitts Agricultural Works, Buffalo, N.Y.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) C. B., Dayton, O., asks: Is "Spence's metal" for sale in this country? *A.*—No; it is manufactured and for sale by J. Berger Spence & Co., London, England.

(2) R. W. B., New York City, asks for figures, according to our judgment, concerning the number of screw-cutting lathes in use in the United States. We confess our inability to answer this correspondent, but refer him to Prof. W. P. Trowbridge, of Columbia College, New York, who takes the census of power and manufactures.

(3) D A., Covington, Ky., writes: Enclosed please find diagrams taken from a slide valve throttling engine by a Richards Indicator, scale 24, boiler pressure=60 lbs, revolutions=76 per minute. Slide valve engine, 23″×14¼″, area 159.48 inches. Engine throttled by the governor. A pair of friction cards are represented by Fig. 1, taken from the engine while driving itself and the line shaft only, while the other pair, Fig. 2, were taken with a No. 34 Sturtevant fan blower attached. The shell measures about 5 feet and the fan runs at a speed of about 1200 revolutions per minute. It is desirable to run this fan at night by means of a smaller and independent engine. Referring to the enclosed diagrams, what should be the horse power of the engine that you would recommend? *A.*—The H.P. constant, *i. e.*, the H. P. developed for one pound mean effective pressure is 1.4. The m. e. p. of the friction card, Fig. 1, is 5.4 lbs. and of the full card is 16.33; whence the full card, Fig 2, shows 22.86 H. P. and the friction card, Fig. 1, 7.56. The difference of 1.53 H. P. is the net power required to drive the fan. An engine having about 170,000 cubic inches piston displacement per minute is about the right size for the work at 60 lbs. boiler pressure. By piston displacement is meant the product of the piston area into the number of inches traveled by the piston per minute. This enables you to select the right size of engine independent of what proportion or speed may be offered.

(4) A. R. D., Nebraska, Ill., asks: Will you please inform me of a simple and cheap way to galvanize wrought and cast iron? *A.*—The articles to be galvanized must be first cleaned, by placing them in open wooden vessels in water containing three-fourths to one per cent. of common sulphuric acid and allowing them to remain in it until the surface appears clean, or may be rendered so by scouring with a rag or wet sand. According to the amount of acid, this may require from six to twenty-four hours. Fresh acid must be added, according to the length of time used, and the amount of liquid required. When the liquid is saturated with sulphate of iron, as in some cases, the sulphate must also be renewed. After being removed from this bath, the articles should be rinsed in fresh water, and scoured, until they acquire a clean metallic surface. They should then be placed in water in which a little lime has been stirred, until the next operation. After being freed from rust, the articles should be coated with a thin film of zinc, while cold, by means of chloride of zinc. This may be made by filling a glazed earthen vessel, of about two-thirds gallon capacity, three-fourths full of muriatic acid and adding zinc clippings until effervescence ceases. The liquid is then to be turned off from the undissolved zinc and preserved in a glass vessel. For use, it is poured into a sheet zinc vessel of a suitable size and shape for the articles to be coated, and about 1-30 per cent. of finely powdered sal ammoniac added. The articles are then immersed in it, and a scum of fine bubbles forming on the surface of it in from one to two minutes indicates the completion of the operation. The articles are then drained, so that the excess of liquid may flow back into the vessel. The iron articles thus coated with a fine film of zinc are placed on clean sheet iron, heated from beneath, and perfectly dried. They must then be dipped piece by piece, by means of tongs into very hot (though not glowing) molten zinc, for a short time until they acquire the temperature of the zinc. They must then be removed and beaten with wire brushes, or something of that nature, to cause the excess of zinc to fall off. This completes the operation, and the articles should be allowed to cool slowly.

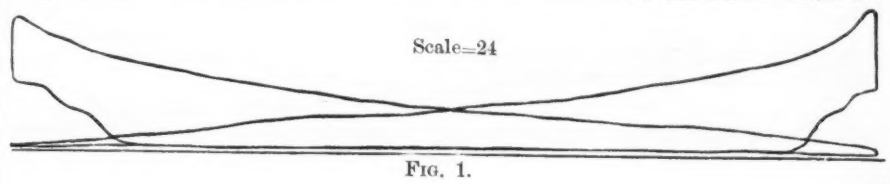


FIG. 1.

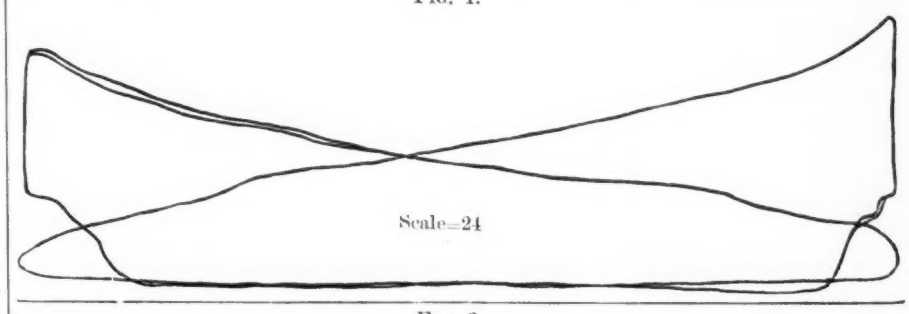


FIG. 2.

Business Specials.

40 cts. a line for each insertion under this head.

Messrs. Thomson, Sterne & Co., (Limited) having most extensive British and Continental connections for the products of their well known works, "The Crown Iron Works," Glasgow, offer the facilities of their works at Glasgow, and their London and Paris offices, for the introduction of American mechanical and engineering inventions in Europe. Reply to Messrs. Thomson, Sterne & Co. (Limited), The Crown Iron Works, Glasgow, Scotland.

American Watch Tool Co., Waltham, Mass., Whitcomb Watch Makers' Lathes, and Watch Machinery.

See Standard Turbine advertisement in last issue.

A 4½ in. 2 Jaw Chuck, Independent or Universal, for Brass Work. A. F. Cushman, Hartford, Conn.

Adjustable Incline Presses. Stiles & Parker Press Co., Middletown. Conn.

For Sale—A New York Steam Engine Co., 21 in. heavy slotter, in good order. Address Southwark Foundry and Machine Co., Philadelphia.

Cylinders, all sizes, bored out in present positions. L.B. Flanders Machine Works, Philadelphia, Pa.

Paper Making Machinery—Makers of above from fibrous material as wood, esparto grass, etc., send address to Joshua Rose, P. O. Box 3306, N. Y. City.

Lathes, Planers, Shapers, Drills, Bolt and Gear-Cutters, Milling Machines. Special Machinery. E. Gould & Eberhardt, Newark, N. J.

Engines, Hoisting and Pumping Machinery for Mines. The Band Friction Hoist, which is the safest, simplest, strongest and best in the market. Also, Friction Clutches. Address, Webster Camp & Lane Machine Co., Akron, O.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease. Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co., Jersey City, N. J.

Wilkinson & Crowell, 1201 Beach St., Philadelphia, make an Improved Metallic Piston Rod Packing, which is entirely automatic and of great durability. Works well at high or low pressure, and can be used in common stuffing box, or without any stuffing box at all.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

John Douglass, common and fine patterns made to order, also car wheels, working models, and experimental machinery. Shop at Washburn, Hunts and Co's Wheel Foundry, cor. Warren and Bay Sts., Jersey City, N. J.

Messrs. Thomson, Sterne & Co., (Limited) of Glasgow, London and Paris, would be pleased to consider proposals for agencies in the principal cities in America, for the sale of their well known Consolidated Emery Wheels and Emery Wheel Machinery, manufactured at their Works, "The Crown Iron Works," Glasgow. The highest medal for Emery Wheels and Emery Wheel Machinery was awarded to this firm by the Jurors of the Paris and Sydney Expositions. Reply to Messrs. Thomson, Sterne & Co., (Limited), The Crown Iron Works, Glasgow, Scotland.

MANUFACTURES.

F. H. Whiting, Youngstown, O., writes us: The Morse Bridge Works have lately put in a Kellogg & Maurice rivet heater, and are now putting in a steam riveter, with cylinder 36 inches in diameter. The same firm has been making for the N. P. P. & O. R. R. some elliptical girders 55 feet long and about 8 feet central diameter.

The certificate of incorporation of the Dart elevating company of Buffalo, for the building of a new elevator, has been filed with the county clerk. Capital stock, $600,000.

Articles of association have been filed with the secretary of state for the incorporation of a new elevator company in Indianapolis, Ind., to be known as the Capital Elevator Company. The stock is placed at $25,000.

Armington & Sims, Lawrence, Mass., manufacturers of the Lawrence steam engine, will soon enlarge their works.

The Knowles Pump Works, at Warren, Mass., will soon build a blacksmith shop near the other shops.

The immense steam pumps in use at the Vulcan Steel Works, St. Louis, which supply the motive power by which all the hydraulic machinery there is operated, were built by Henry R. Worthington, of New York.

Charles City, Iowa, wants a paper mill. The *Advocate*, of that city, says that there is not a better point, nor better and more available power for a mill than Charles City affords.

The Christiana Machine Co. of Christiana, Pa., have recently shipped a 60″ Burnham turbine wheel, and a lot of heavy gearing, to Malloy & Morgan, of Laurel Hill, N. C., to be used in driving the cotton mill at that place.

A print paper mill is wanted at Austin, Texas. A wood pulp mill could be run in connection with it, and the supply of material at low prices is said to be abundant, with good shipping facilities by railway. Ample water power may be had, with plenty of pure water for paper making. There is no paper mill in Texas at present.

F. W. Eames, of the Eames Vacuum Brake Co., Watertown, N.Y., has purchased the new speed-locomotive built by the Baldwin Locomotive Works. It will be fitted up with the vacuum brake and shipped to London, where Mr. Eames purposes using it for brake tests, at the same time comparing the merits of American and English locomotives.

The Hampden Foundry & Machine Co., of Boston, have furnished one of their large sized Feed Water Heaters to the Boston Gas Light Co.; another to the Mayo Planing Mills, Boston, and still another to the East Boston Pumping Station.

The *Red River Valley News* says that Ada, Dakota, wants a flouring mill.

Wheeler Madden & Clemson, Middletown, N. Y., have set a boiler with the Jarvis Furnace.

The Ohio Paper Company's mills at Miamisburg (O.) are rapidly approaching completion, and the rolls are now being ground preparatory to furnishing the engines.

Munn & Baush, the Holyoke iron founders, contemplate the enlargement of their works at an early date.

The Turners Falls (Mass.) Paper Company are to build an addition of 50 feet to their new mills.

The Central Woolen Mills at Uxbridge, Mass., are about to erect a carpenter and machine shop in place of those burned several weeks ago. The new buildings will be 50x30 feet, and two stories high.

Dunbar, Hobart & Whidden, of South Abington, Mass., are to add fifty new tack machines to their equipment.

A stock company for the manufacture of the Onslow scale, has been organized at Kingston, N. Y., with a capital of $26,000 The company will at once begin the erection of a factory.

A cotton factory is to be established at Orangeburg, S. C.

G. & H. Barnett, file manufacturers of Philadelphia, are to enlarge their factory, and to this end have purchased the property adjoining their present establishment, which has dimensions, 20 by 150 feet.

The Hudson River Paper Mill, at Stillwater, N. Y., is to be entirely remodeled and improvements made which will double its capacity.

The P., D. & E. Railroad is erecting shops and a ten stall round house at Mattoon, Ill.

The town of Wilton, N.H., voted to exempt from taxation, for a term of ten years, the new mill and machinery proposed to be placed on the site of the Wilton Manufacturing Co.

Extensive locomotive works are to be established at Toronto, Canada.

There will soon be erected a plow factory in Atlanta, Ga., and a broom and bucket factory at Albany, Ga.

There is talk of establishing a large silk factory at Cohoes, N.Y.

Messrs. Dushane & Co., paper manufacturers, Morgan, Md , are setting a Babcock & Wilcox boiler with the Jarvis furnace to burn screenings without a blower.

The Potsdam Paper Company (Limited), has been organized at Potsdam, St. Lawrence County, N.Y. The capital stock is $20,000. E. D. Brooks, President ; Hosea Bicknell, Treasurer, and M. H. Brown, Secretary.

The Atlas Engine Works, Indianapolis, Ind., have put flanges on the wheels of one of their traction farm engines and are using it to switch cars about their shops. It pulls 10 empty cars easily, and is very handy.

A company has been organized at Cuero, Texas, to engage in the manufacture of yarn from seed cotton, under the Clement attachment process. Hitherto cotton had to be ginned, or freed from the seed before being manufactured into yarns or cloths, but with the Clement attachment, of which several are now in use, the cotton is taken directly from the fields and manufactured.

One thousand dollars and the best mill site in southwestern Nebraska, will be given by the citizens of Alma, to the party who will build a first-class mill there at once.

Excavating has begun for the erection of a large elevator in Hastings, Minn., by the Chicago, Milwaukee and St. Paul Co. The capacity of the building will be upward of 100,000 bushels of grain.

The Cincinnati Brass Works are having built on Eighth Street, a factory which will cost $15,000.

The Simonds Manufacturing Company., Fitchburg, Mass., are making extensive additions to their shops.

J. Trull, Boston, Mass., is to have a brick manufactury at 41 to 45 Bowker Street. Thos. J. Whidden is the architect.

C. Hoffman, 225 Water street, Brooklyn, has just received a lot of shafting from Styles & Parker, of Middletown, Conn.

The Central Mills Co. of Southbridge, Mass., will pay 10 per cent. for their July semi-annual dividend.—*Mass. Spy.*

Eliza A. Harlan, Brooklyn, is having a factory built on Pulaski St., near Marcy Ave., which will cost about $3,500. J. H. Smith is architect and builder.

A brick factory for Richardson, Boynton & Co., costing $8,000, is to be erected on the corner of Van Brunt and Broome Sts., Brooklyn. The architect is G. L. Morse.

The American Color Printing Co., of Middletown, O., has been incorporated, with capital $18,000.

W. G. J. Wheeler, 66th St., near First Ave., New York city, is to have a brick factory costing $7,000. The architect is John C. Burne.

A brick building for a factory, costing $4,000, is to be erected at 293-295 Monroe St., New York city, for Jacob Henkel. Julius Jordan is the architect.

A distillery, costing $35,000 is to be built in Chicago on the corner of Blackhawk Street and Elston Avenue.

Machinists' and Engineers' Supplies.

NEW YORK, August 5. 1880.

There are no important changes in the supply market since our last report. The prospects for the near future are unchanged. There are numerous inquiries and we hear of a slight advance in prices which have been demanded and obtained in some cases. In many cases, the advance spoken of appears to be more on the surface than in reality.

We are in receipt of a very handsome 60-page Illustrated Catalogue of heavy wood-working machinery designed for the use of car and railroad shops, arsenals, ship and navy yards, etc., and published by J. A. Fay & Co., 261 to 285 Front street, Cincinnati, O. It is a pity that such a handsome and valuable publication should not have substantial cloth covers. The book contains much valuable information regarding the construction and use of wood-working tools.

Rowley & Hermance, Williamsport, Pa., have issued an 1880 edition of their classified catalogue of wood working machinery. The book contains about 60 pages, and relates to a large variety of tools, many of which are new.

We are informed that the Penfield Block Works, Lockport, N. Y., have perfected, and are now ready to furnish, a new bushing for iron or lignumvitæ Sheaves, which they call their "Phosphor-Bronze Self-lubricating Bushing." They charge extra for Sheaves with these bushings, over the price of Sheaves with plain iron bushings.

We have received the following circular which will explain itself.

THE MACHINE TOOL WORKS, Twenty-fourth and Wood Streets, Philadelphia.

Railroad Companies, Machine Shops, and others requiring machine tools, are informed that these Works (hitherto known as "Ferris & Miles") are organized on a permanent basis for the manufacture of Steam Hammers and Machine Tools, under the proprietorship of Mr. James Dougherty, of Bement & Dougherty, and the management of Mr. Frederick B. Miles, of Ferris & Miles, both of Philadelphia. The reputation of Mr. Dougherty, so long and favorably known as a successful builder of Machine tools, is in itself a guarantee that purchasers will receive articles of strictly first-class character only, while that of Mr. Miles will assure all friends and customers of Ferris & Miles that the Steam Hammers and Machine Tools will be constructed, as heretofore, in a careful, thorough and efficient manner. The patrons of the parties are solicited to continue their favors.

Wm. Main, well known to the readers of the AMERICAN MACHINIST, as mining engineer and metallurgist, has formed a partnership with A. K. Eaton, analytical chemist, who, by the way, is not the one Dickens referred to in description of Podsnap's dinner party. The firm name is Eaton & Main. They will analyze ores, and conduct a general business in the way of consulting mining engineers, besides instructing students in their line, at 65 Henry Street, Brooklyn, N. Y.

Iron Review.

NEW YORK, August 5, 1880.

Prices of iron, both pig and manufactured, are steady with some tendency to go higher. Buyers are holding off, to see whether prices will be sustained. Present quotations of pig are No. 1, $25 to $26, No. 2, $23 to $24, Forge, $22, Eglinton, $23, Coltness, $25, Glengarnock, $23 and Gartscherrie, $23.50.

Pierson & Co., 24 Broadway. N. Y., under date of July 29, 1880, quote prices out of store as follows:

Iron Rails, $50 to $57, according to weight; Fish Plates, 2¾c. per lb.; Railway Spikes, 3c.; Bolts and Nuts, 3½c.; Common Bar Iron, 2.4c., basis from store; Refined do. 2.6c., basis; Ulster, 3.6-10c. basis; Machinery Steel, 6½c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 6¾c.; Sheet Iron, 3½c., basis; Angle Iron, 3¼c.; Tee Iron, 3¾c.; Band Iron, 3.4c.; Hoop Iron, 3.6c., and up according to size; Horse Shoe Iron, 3.3c.; Hot Polished Shafting in tengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Makers' Supplies as follows:

Flange, 5¼c.; C. H. No. 1 Shell, 4c.; Tank, 3½c.; C. No. 1, 3¾c.; Sheet, 3½c; Angles, 3½c. Boiler Tubes 45% discount from list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of August 5, 1880:

No material change in metal market since our last. Demand continues fair, more buyers than sellers. Pig Tin in London about £91; Singapore, $28. This market nominally, Banca, 22¾c; Malacca and Straits, 21½c. Billiton, Australian, English Refined and Lamb and Flag, 21c.; Pig Lead 4½c.; Antimony, 16½c. to 17½c. according to brands; Spelter, "Bertha," pure, 9c.; Western 5½c.; Silesian, 6c.; Solder, No. 1, 11½c., "Half and Half," 13c. Cable reports this morning an advance in London of 2 pounds per ton with a large business.

WANTED.

Wanted—Machinists—Six strictly first-class Vise hands and Fitters accustomed to building machine tools; liberal wages paid by Niles Tool Works, Hamilton, Ohio.

An experienced machinery iron works Superintendent wishes to engage with reliable parties. Address, P. H. L. care AMERICAN MACHINIST office.

Wanted.—A situation as Supt. or Foreman of a foundry or machine shop by a man of experience; a draughtsman and a thorough mechanic. No objection to south or west. Address Mechanic, P. O. box 1338, Boston, Mass.

Wanted by a Mech. Engineer and Draughtsman, 16 years experience, situation as Superintendent or Draughtsman. Address C. R., Box 444, Worcester, Mass.

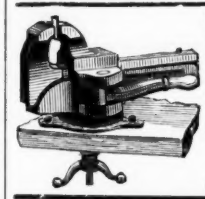
FOR SALE.

A part interest in western shop. Spring and summer profits have averaged $1,000.00 per month. Purchaser must be able to manage shop, as it is the managing partner who is compelled to sell. Address

JAMES W. SEE,
Consulting Engineer,
HAMILTON, OHIO.

Drawing Instruments
AND MATERIAL, PAPER, &C.
G. S. WOOLMAN,
116 Fulton Street, New York.
Fully priced and illustrated Catalogues.

RALPH R. OSGOOD'S BOOM DREDGE.
Adapted to all kinds of under-water excavation. Guaranteed to excavate 50 per cent. more material from hard bottom than any other machine made, all things being equal. Illustrative pamphlets, comparative strain sheets and estimates furnished on application. See AMERICAN MACHINIST of July 31, 1880. Address
RALPH R. OSGOOD, Troy, N. Y.
When in New York City will be 81 Astor House.



STEPHENS' PATENT PARALLEL VISE and attachments, adapted to every variety of work from Jewelers' to Locomotive Shops. It opens **further,** holds **firmer,** is **heavier** and more **durable** than any other vise. For sale by the trade.
Stephens' Patent Vise Co.
41 Dey St., New York, U. S. A.

FOR SALE.
A Works completely equipped for the manufacturing of carriage axles; is well located in relation to Coal and Iron, also very accessible to market. Address
E. P. BULLARD,
14 Dey Street, New York.

Mechanical Books.
Send 10 cents for 96 page Catalogue of Books for Machinists and Engineers.
D. VAN NOSTRAND,
23 Murray & 27 Warren Sts., New York.

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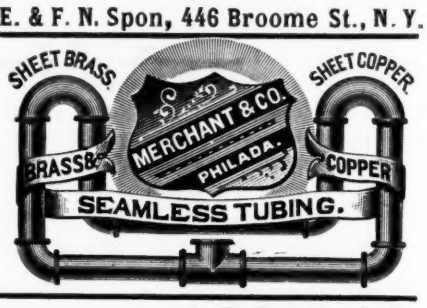
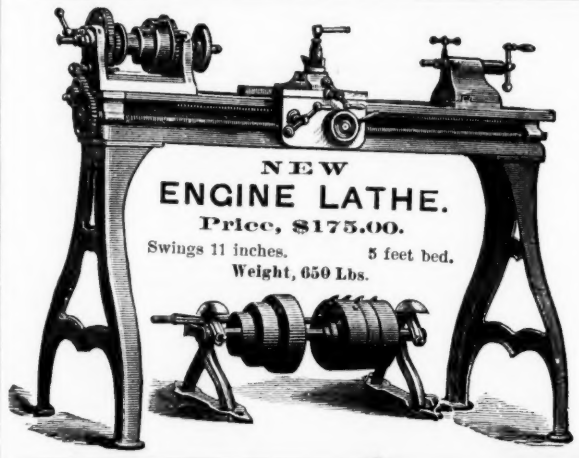
WORKSHOP RECEIPTS
For the use of manufacturers, mechanics and scientific amateurs.
By ERNEST SPON.
Crown, 8vo, illustrated. Price, $2.00. Send for Catalogue of books for practical engineers.
E. & F. N. Spon, 446 Broome St., N. Y.





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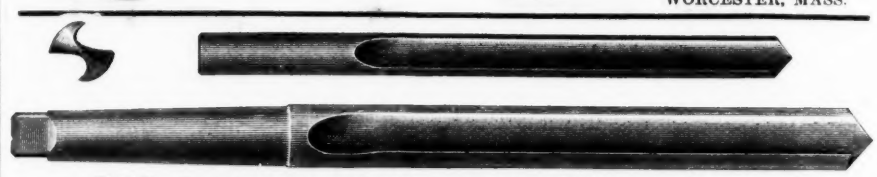
Manufacturers of
Light Machinists' Tools.
Improved Upright Drills, with Lever Feed and Wheel Feed with Quick Return Motion.
Hand and Foot Power Lathes.
SLIDE RESTS.
Special Machinery and Machine Jobbing.
FOOT POWER LATHES A SPECIALTY.
54 Hermon Street,
WORCESTER, MASS.



THE FARMER LATHE-DRILL AND TOOL CO.
LEOMINSTER, MASS., U. S. A.
MANUFACTURERS OF
Drills and Machinist's Small Tools.
Attention given to making Drills for special purposes, either straight, flute or twisted. Also, manufacturers of the New Patent Lathe-Drills, to which we would call the attention of those who work in Copper, Brass and the softer metals. For price list and further information address as above, or
L. B. RUSSELL, Gen. Agent, 96½ Summer St., Boston, Mass.

THE NEW PULSOMETER
Is more Economical in Points of Original Cost, Expense for Repairs and Running Expenses, than any other Steam Pump in the World.

Simple and compact, with no machinery whatever to oil, or get out of order, it stands at the head of all means of elevating water or other liquids by steam. *It needs no skilled labor to look after it.* Send for book giving full description, reduced prices, and many letters of commendation from leading manufacturers and others throughout the country who are using them.
PULSOMETER STEAM PUMP CO.
Sole Owners of Hall's Patents in the U. S., 131, 515 to 131, 543, both inclusive, and the
NEW PULSOMETER,
P. O. Box No. 1533. Office, No. 83 John St., New York City.

KEARNEY & FOOT
Office, No. 78 Chambers Street, N. Y. Full Weight Hand-Cut Files. Manufactory, PATERSON, N. J.
The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.
NORTH RIVER IRON WORKS.
TO WHOM IT MAY CONCERN: New York, May 1st, 1877.
We have used the Files made and re-cut by Messrs. WEINMANN & KEARNEY for the past three years, and we know of no better recommendation than the fact that we are still using them.
FLETCHER, HARRISON & CO.
WINCHESTER REPEATING ARMS CO.
Messrs. KEARNEY & FOOT, New York, New Haven, Conn., Nov. 1st, 1878.
Dear Sirs:—The Files you have been furnishing this Company have proved equal to, if not superior, to any heretofore used. Yours truly, V. A. KING, Sup't.
We print instructions on the use of Files, and also give the diameters of round and square Files from 3 to 16 inches. They are on card board, 10x12 in., and are intended to be put up in the shop for the men to read. We are pleased to mail them to any manufacturer on receipt of the necessary 6 cents postage.
Respectfully, KEARNEY & FOOT.

NICHOLSON FILE CO.

SOLE MANUFACTURERS OF

FILES AND RASPS

HAVING THE INCREMENT CUT.

Also, FILERS' TOOLS and SPECIALTIES.

"Nicholson File Co's" Files and Rasps.
"Double Ender" Saw Files.
"Slim" Saw Files.
"Racer" Horse Rasps.
Handled Rifflers.
Machinists' Scrapers.
File Brushes, File Cards.
Surface File Holders.
Vice File Holders.
Stub Files and Holders.
Improved Butchers' Steels.

Manufactory and Offices at **PROVIDENCE, R. I., U. S. A.**

NEWARK STEEL WORKS.

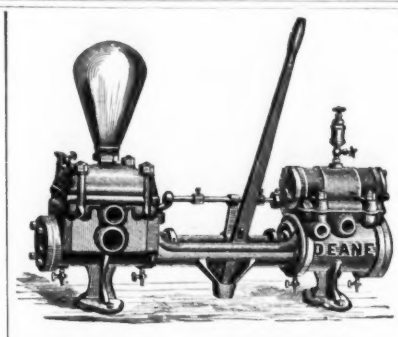
BENJAMIN ATHA & CO.

MANUFACTURERS OF

CAST STEEL

WE MAKE GRADES OF STEEL SPECIALLY ADAPTED TO THE MANUFACTURE OF LATHE TOOLS, CHISELS, TAPS & DIES

BENJ. ATHA. NEWARK, NEW JERSEY. J. ILLINGWORTH.



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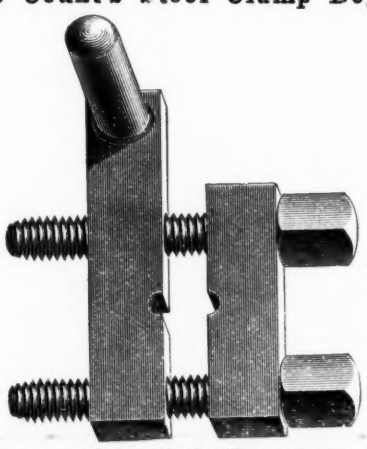

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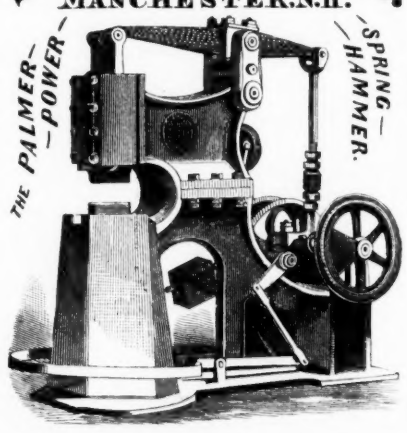

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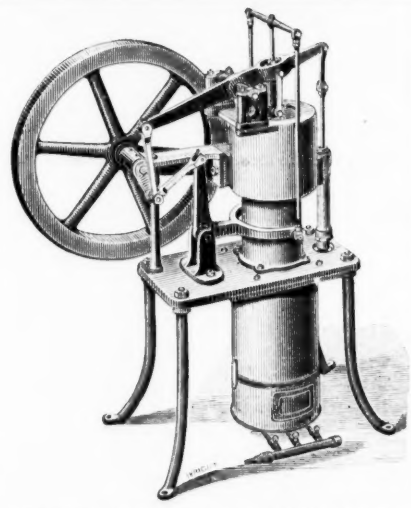

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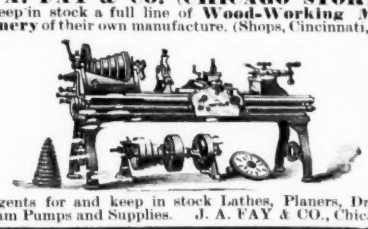

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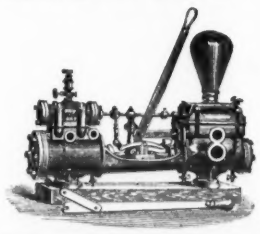

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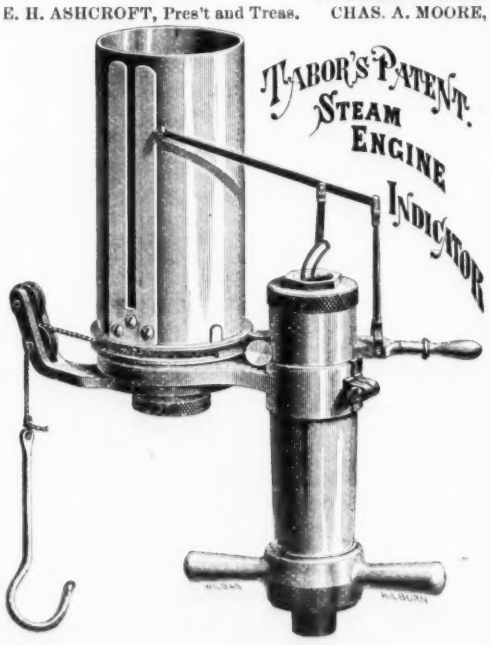

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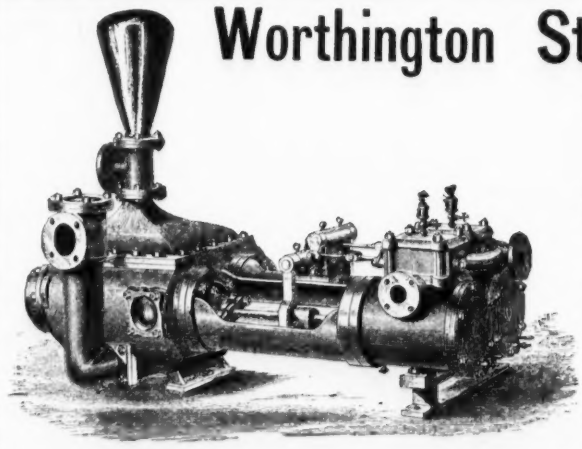

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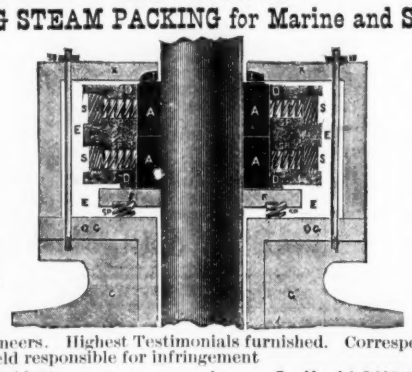

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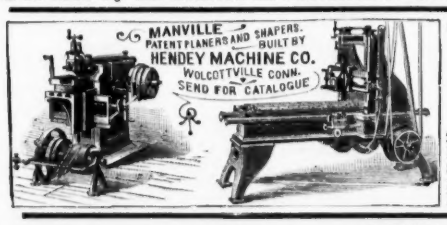

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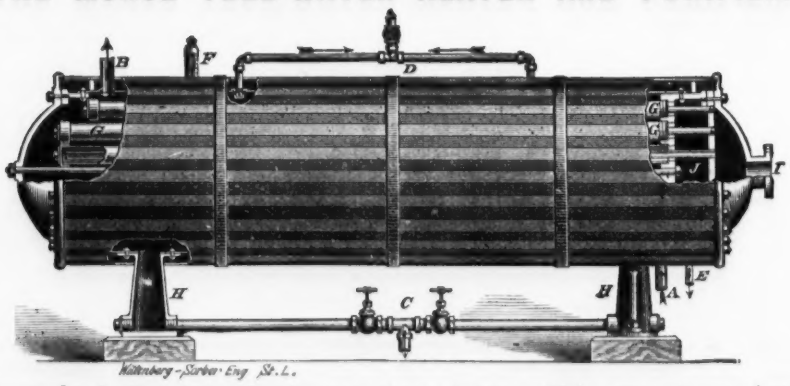

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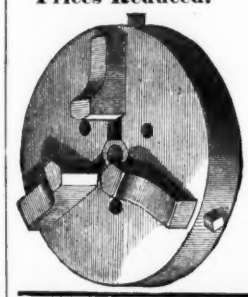

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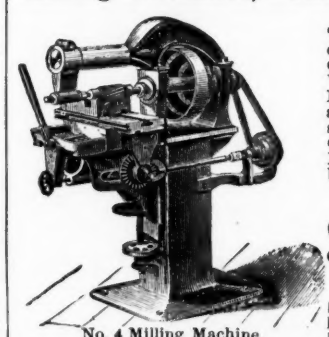

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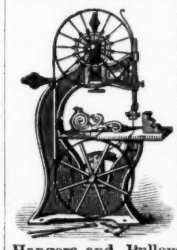

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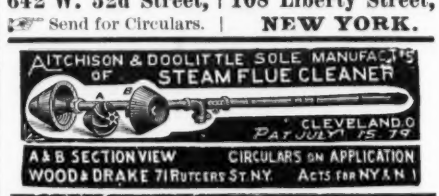
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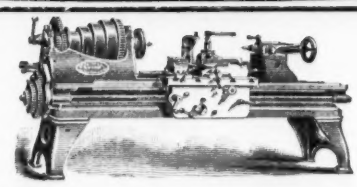

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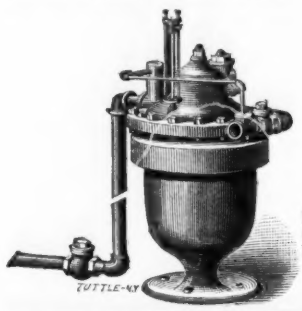

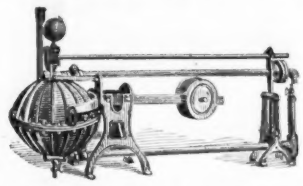

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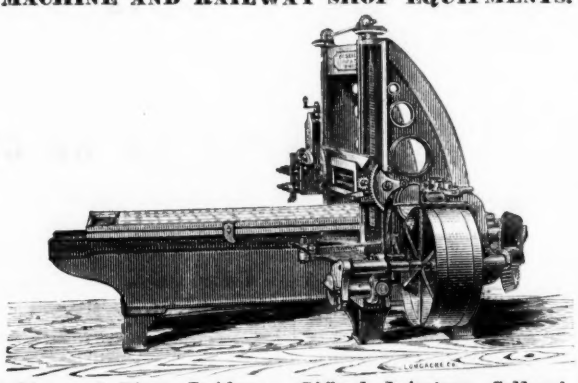

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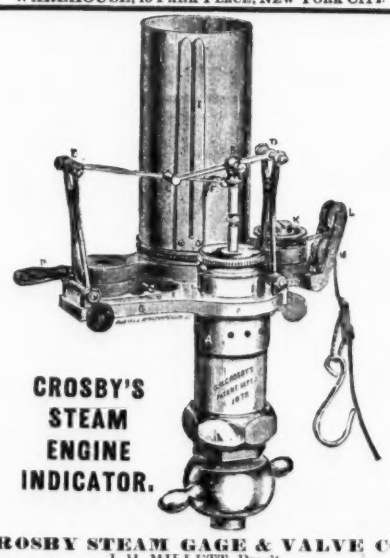

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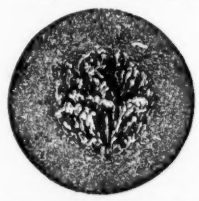

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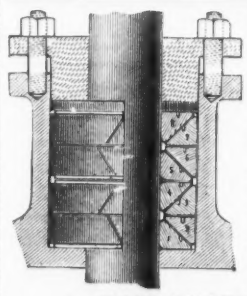

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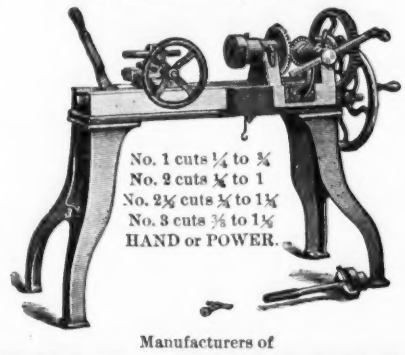

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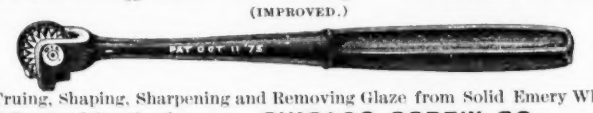

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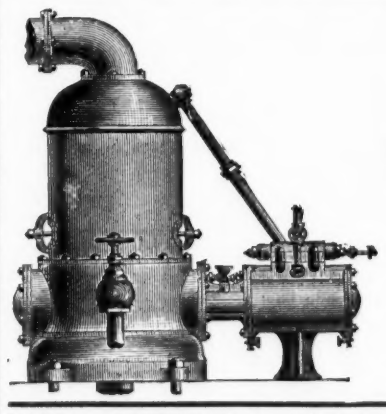

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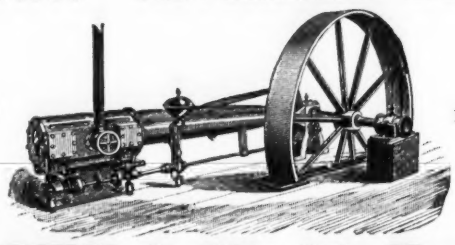

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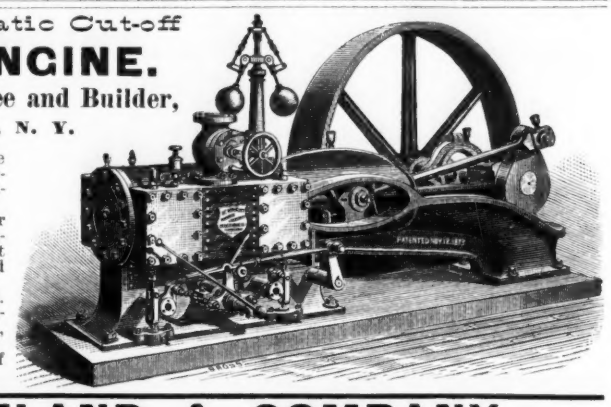

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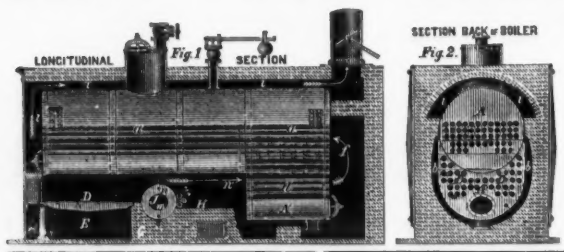

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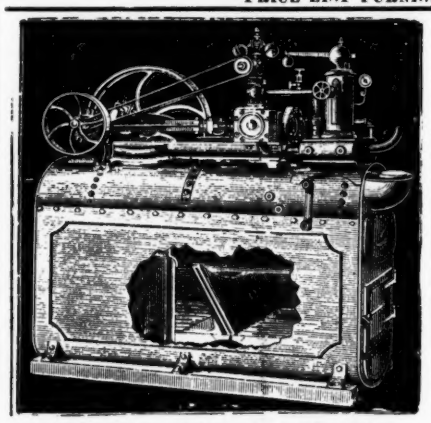

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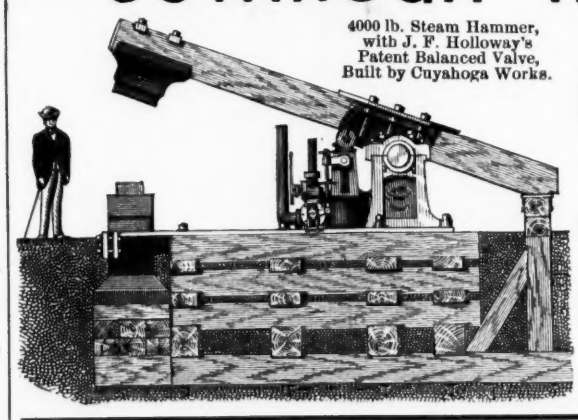

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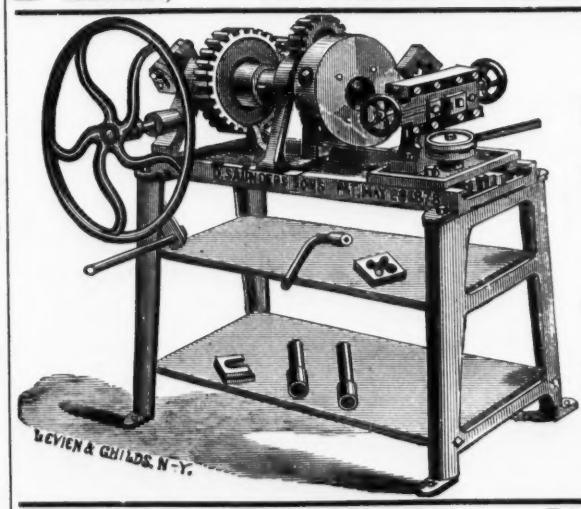

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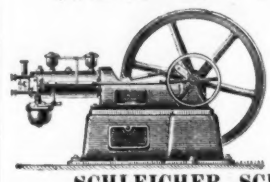

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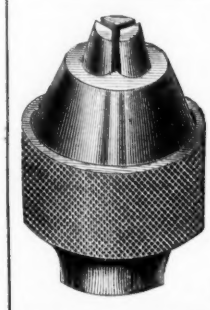

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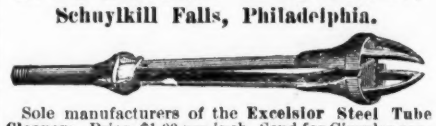

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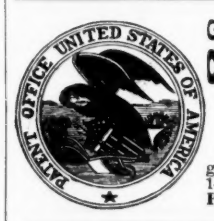

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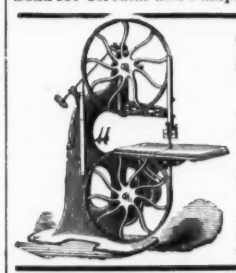

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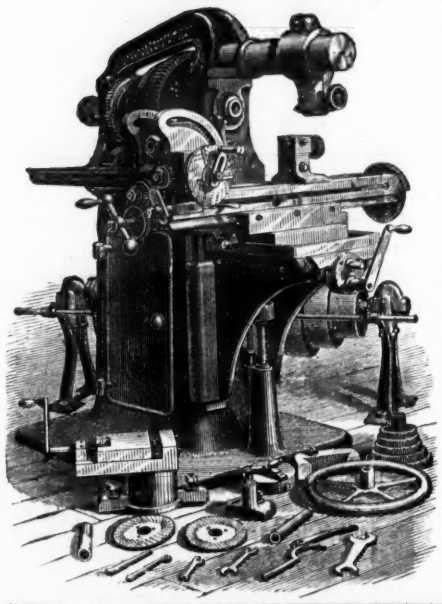

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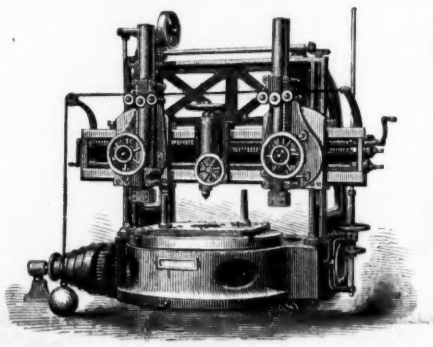

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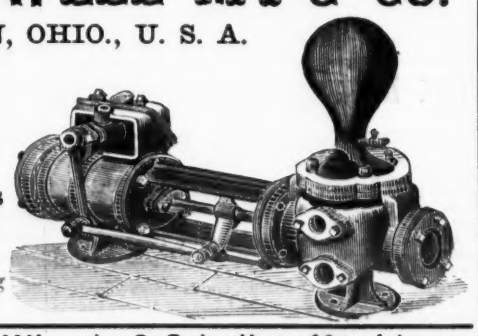

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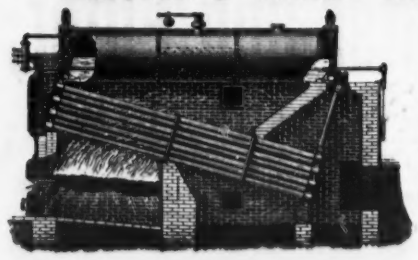

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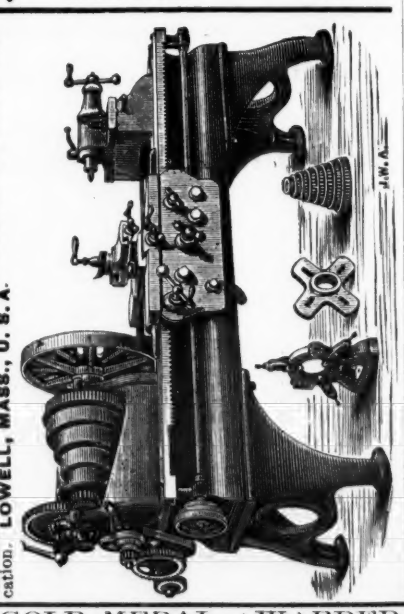

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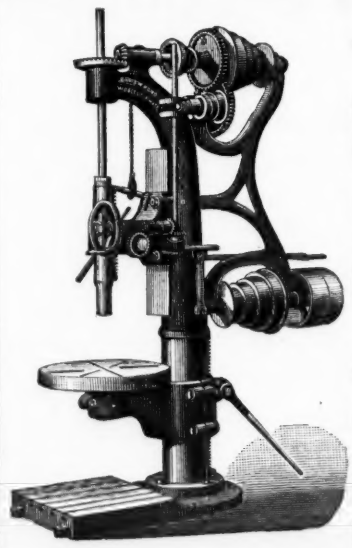

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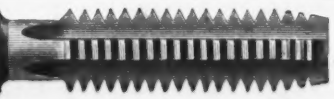

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